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The

Tropical Agriculturist

DECEMBER, 1941

EDITORIAL

AFTER 60 YEARS.

THIS is the last monthly issue of *The Tropical Agriculturist.* Hereafter it will appear as a quarterly publication. This major change after 60 years is a landmark in our history and our readers may find interest in a brief retrospective survey of ourselves.

The Tropical Agriculturist was first published in June, 1881, by Messrs. A. M. & J. Ferguson of the " Observer " Press. It was essentially a planters' journal. It served both as a clearing house of practical planting experience and as a medium for presenting to the planters agricultural information culled from publications throughout the world. Writing twenty-four years later Mr. E. B. Denham described it as " a recognised reference work on all matters connected with agriculture in the Tropics ". This was a correct description of *The Tropical Agriculturist* during the first quarter century of its existence except in one respect : its interest was very largely restricted to commercial agriculture as opposed to consumption agriculture of the peasant. This was the period of the discovery and the rapid expansion of the primary commodities of the tropics which fed the factories of Europe, and the planters were experimenting with new crops and seeking information with regard to their cultivation and preparation for the market. *The Tropical Agriculturist* brought them this information.

The Ceylon Agricultural Society was founded in October, 1904, and started its own journal. Mr. Ferguson felt that it would be wise to " coalesce forces utilizing certain features of *The Tropical Agriculturist* and making the most of the prestige which it had acquired especially outside the Island ". The amalgamation was effected in 1905, and in July of that year appeared the first number of *The Tropical Agriculturist and Magazine of the Ceylon Agricultural Society.* Dr. J. C. Willis, Director, Royal Botanic Gardens, was the Editor, and the new publication with the

complicated name began to acquire a greater scientific and academic bias than it had when there was no official association, and to lose its popularity with the planters.

The joint ownership continued till 1913, when the Fergusons sold their half share to the Agricultural Society which thus became the sole owner. The only evidence of the change which the journal showed was in the title. The first number after the change appeared in March, 1913, as—

The Tropical Agriculturist :
Journal of the
Ceylon Agricultural Society.

The progressive change of the character of the journal from a popular to a semi-scientific magazine was accelerated in 1921 when, with the absorption of the Ceylon Agricultural Society by the Department of Agriculture, *The Tropical Agriculturist* became the official journal of that Department, and the Director of Agriculture its *ex officio* editor. The Research Officers of the Department began to publish the results of their more elementary experiments in *The Tropical Agriculturist* whose contents began to be divided into two distinct parts—original contributions from scientific officers and reproductions of articles which might have a local or general interest from other journals. To-day it has come to occupy the status of one of the most important semi-scientific publications of the tropical world.

A reference to our printers would be of special interest because perhaps the present change is due in large measure to the change of printers. The "Observer" Press printed *The Tropical Agriculturist* from its birth till the Ceylon Agricultural Society became the sole proprietors in 1913. From that year till the end of 1935 Messrs. H. W. Cave & Co., were the printers. About this time the Treasury raised the point that the usual Government practice of calling for tenders for every service under Government should be applied to *The Tropical Agriculturist* and thus Messrs. Colombo Apothecaries, Ltd., became the printers by successful tender. The Treasury went one step further in 1938 when it was decided that the Government Press should print the journal. The Editor lost in this manner the independence of action which he had enjoyed for over half a century.

THE CULTIVATION OF GINGELLY IN CEYLON

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ONE of the earliest known oil bearing plants in the world is *Sesamum orientale* Linn, (*S. indicum* Linn), commonly called gingelly in Ceylon and South India and til in North India. It is a quick growing annual, extensively cultivated for its small seed in the warmer and drier regions of the tropics such as parts of Africa, India, and China. In Ceylon, it is the main money crop of the *chena*.

The seed is valued for its oil which in the tropics is used for cooking and other domestic purposes and in Europe for the manufacture of margarine, soap and perfumes, being a good substitute for the more expensive olive oil. The raw seed both whole and crushed is favoured in India and Ceylon as an ingredient in the domestic preparation of sweetmeats. Apart from being one of the richest sources of oil, gingelly seed contains a high proportion of protein, calcium and phosphorus as will be seen from the analyses quoted later in this article. The cake or poonac which remains as a residue after the oil is expressed is an important feeding stuff for livestock.

As the local production of gingelly is not sufficient to meet the Island's requirements, seed, oil and poonac are annually imported from India. The following table gives the figures of imports and exports during the last 5 years :—

Table I. Showing the imports and exports of gingelly seed, oil and poonac from 1935.

	Imports.		Exports.	
	Quantity. Cwt.	Value. Rs.	Quantity. Cwt.	Value. Rs.
1935.				
Seed	27,598	218,540	345	2,156
Oil	303	7,795	28	905
Poonac	213,049	1,376,692	—	—
1936.				
Seed	47,924	376,046	19	78
Oil	467	11,922	46	2,824
Poonac	266,791	1,507,832	—	—

	Imports. Quantity. Cwt.	Imports. Value. Rs.	Exports. Quantity. Cwt.	Exports. Value. Rs.
		1937.		
Seed	42,389	348,339	123	650
Oil	1,843	39,995	2,185	29,539
Poonac	295,131	1,635,113	—	—
		1938.		
Seed	32,254	235,174	—	—
Oil	4,991	107,343	101	3,801
Poonac	277,657	1,666,642	—	—
		1939.		
Seed	18,379	132,737	—	—
Oil	6,393	140,535	679	8,128
Poonac	273,091	1,467,536	—	—
		1940.		
Seed	9,655	84,071	132	899
Oil	9,055	210,930	66	1,331
Poonac	255,169	1,946,518	—	—

It will be noted that the imports of seed have fallen considerably while those of oil have increased. This is largely due to the fact that within recent years there has been an increasing demand for the better quality Indian milled oil, specially amongst the Indian community in Ceylon. The import figures for poonac remain at a level. The exports are negligible.

Origin and Botanical Description.—The cultivated varieties belong to the single species *S. orientale* Linn., a member of the family *Pedaliaceae*, but there is some uncertainty as to the exact origin of the crop. It is widely cultivated in north-east Africa where 10 out of the 12 known species of *Sesamum* occur in the wild state while on the other hand in India a striking diversity of forms is seen. The general evidence, however, points to Africa as being the primary centre of origin with India and Japan as secondary centres.

The plant is an erect herb, which grows to a height of 2–4 ft. The stems are hairy and generally 4 sided. Certain varieties are branched.

The leaves may be bluish green and simple, opposite or alternate. They are polymorphic, the lower leaves being large while those nearer the apex tend to become linear. They may be entire, excised or lobed. Mucilaginous hairs are present.

The flowers are borne either singly or in groups of 2–3 on short pedicels in the axils of the leaves, though usually only one develops. Flowering commences from the base of the stem upwards in 3–8 weeks time from sowing, according to the variety.

The corolla is bilobed and its colour varies from white, a tinge of purple to a reddish purple, the lip of the lower lobe being sometimes a deeper colour than the rest of the corolla. On the throat of the corolla, deeper colour spots and hairs are present.

There are four anthers of which two are longer and lie at the same level as the bifid stigma. The anthers dehisce before the flower opens early morning and as the stigmas are receptive at the same time self pollination takes place. The flowers are visited later in the day by insects. Abortion of the stamens is, however, not uncommon and cross fertilization thus takes place.

The capsule is pubescent, oblong and bilocular, each loculus being sub-divided by a false septum. It is green in colour turning brown when fully ripe and dehiscing from the apex leaving the central wall with its seeds free.

The seeds are smooth, small, ovoid and flattened. They number about 200,000 per lb. and their colour varies from white, grey, brown to black. Black seed is a genetic dominant to brown and both to white. The seed coat encloses an embryo with clearly distinguished cotyledons and radicle. Albumen is little developed. Analysis of the seed carried out in the Chemical Division shows the following percentages :—

Protein 20·14. Fat 50·76. Calcium 1·38. Phosphorus ·50. Iron ·015. Carbohydrate 16·59.

Varieties and Selections.—There are several varieties based on the colour of the seed, time of maturity, degree of branching, number of capsules per leaf axil, yield and the quality and quantity of the oil.

White seed varieties are generally preferred because they usually contain a higher percentage and a better quality of oil than the brown or black seed varieties. Trials are being conducted at the Pelwehera Experiment Station, Dambulla, with a white seed variety from Gujerat as regards its suitability under Ceylon conditions from the point of view of growth, yield and keeping quality. Its oil content in comparison with a recommended selection (Burma No. 3) and a local variety is given below from analyses carried out in the Chemical Division :—

	Colour of Seed.	Age in Days.	Moisture. Per Cent.	Oil. Per Cent.
1. Gujerat var	White	64	5·58	47·3
2. Burma No. 3	Black	68	5·62	39·4
3. Local	Brown	80	5·66	42·3

There are early, medium and late varieties whose ages vary from just over 2 to 4½ months. Most of the Ceylon varieties take 2½ to 3 months. The maturation period, branching and the root system show a genetic correlation.

The yield of seed and the percentage and quality of oil are important characters in breeding and selection work.

Soil and Climate.—The crop requires a well-drained sandy loam which is well supplied with lime. It does not grow successfuly on heavy soils. A warm dry climate with light rains during the early stages of growth is needed. Heavy rains are detrimental to the crop which is, therefore, only grown during the south-west monsoon season (*yala*) in the dry zone areas of the Island. If sown for the north-east monsoon (*maha*) the crop is severely affected by pests and diseases.

Systems of Cropping.—In Ceylon gingelly is commonly grown in *chenas* after the previous *maha* crop of *kurakkan*. Some *chenas* are, however, especially in the North-Central Province cleared for the first time for a *yala* crop and are sown with gingelly which is followed by *kurakkan* in the next *maha* season. In the Jaffna Peninsula, gingelly is sown after the harvest of the paddy or tobacco crop on paddy land either alone or mixed with *kurakkan* and green gram. The usual mixed crops with gingelly in India are *Pennisetum* millet (cumbu), sorghum, cotton or dhal.

In dry land mixed farming schemes suggested for the dry zone, gingelly may be grown for the *yala* season in rotation with kurakkan, green gram, dhal, chillies, *cumbu* and Bombay cowpea. It is also recommended for the *yala* season in fields situated under village tanks, where the soil is light and water supply is inadequate for two paddy crops in the year. It should be sown in alternate rows with green gram or the bush cowpea variety from Bombay.

Method of Cultivation.—Except in *chena* planting the soil should be ploughed with an iron plough, manured with compost at the rate of about 5 tons per acre, and harrowed until a fine seed bed is produced.

The seed should be drilled in shallow rows about 1 to 1½ ft. apart with a seed rate of about 2 lb. per acre or in alternate rows 1½ ft. apart with green gram or Bombay cowpea. Being small and light, the seed should be mixed with dry ash or sand, so as to ensure its even distribution in the row and it should then be lightly covered over with soil by mamotties or a tooth or brushwood harrow. If heavy rain occurs after sowing, germination becomes uneven.

The cotyledons appear above ground in about 4–6 days. The seedlings are delicate and cannot withstand heavy rain. When they are about 2–3 weeks old, they should be thinned out to about 6–8 in. in the row hoeing the soil at the same time. If a leguminous intercrop is sown only 2 weedings will be necessary.

Harvesting and Yields.—When the leaves turn yellow and drop, the first formed capsules which have turned brown begin to

burst and harvesting should be carried out at this stage. If it is delayed the capsules become shattered and considerable loss results.

The crop is harvested with the sickle by cutting down the plants to ground level. They are tied in bundles of convenient size and carried to a shed with a clean hard floor and open sides where they are heaped with their butt ends resting on the ground and allowed to remain for about 7 days. If such accommodation is not available, the stooks should be covered over with gunny bags to protect them from the sun. During this period all the leaves drop and the capsules turn brown. The bundles are then taken to an open drying floor on which a mat is spread, if a smooth clean floor is not available. The capsules burst with exposure to sun and most of the seeds are shed. In order to ensure the removal of all the remaining seeds, the capsules are beaten with a mallet or a wooden roller is passed over them several times. The seeds are then separated from the chaff and dust by winnowing.

As a single crop, the yield of clean seed may vary from 300 to 600 lb. per acre. In *chenas*, the usual yield is about 300 lb. per acre. The bushel weight varies from 46 to 52 lb. The local price varies from Rs. 3 to Rs. 4·50 a bushel, but Rs. 3·50 is considered to be a satisfactory price to the grower in Ceylon.

Extraction of Oil.—The percentage of oil varies from 35 to 47 according to the variety and the method of extraction. In Europe and America the oil is extracted by means of hydraulic mills. The usual local method of extraction is in a *chekku* which is a wooden press revolved by bullocks moving round in a circle. The seeds are first soaked and then rubbed to remove the husks. After drying they are subject to pressure in the *chekku*.

A bushel of seed of the local varieties yields in a *chekku* about 12 bottles (18 lb.) of oil or about 35 per cent. while with a hydraulic mill about 42 per cent. of oil can be extracted. In North India, the improved *chekku* mill gives about 42 per cent. of oil for white seed varieties while the hydraulic mills in Bombay extract 45 per cent. or more.

The white seed varieties give a better quality oil than the coloured varieties. A bottle of oil is valued in Ceylon at about 75 cents.

The poonac contains about 6 per cent. nitrogen and 40–43 per cent. protein, as compared with 21 per cent. for mill coconut *poonac* and 18 per cent. for *chekku* coconut *poonac*. It is also rich in calcium. It is of interest to note that butter made from milk produced by cows fed on coconut *poonac* is of a firmer texture and has a higher melting point than butter from the milk of cows fed on gingelly *poonac*. On the other hand, the

keeping qualities of coconut *poonac* are inferior and as it swells in the presence of water and causes undue distension in the stomach of cattle if fed dry in large quantities it should be soaked thoroughly before feeding, while gingelly *poonac* can be safely fed in the dry condition*.

Storage.—Seed gingelly should be stored in clean bins with tight fitting lids or in the local *bissas.* The seed should first be throughly dried in the sun and while still hot placed in the bins or *bissas* with a layer of clean dry sand on top to a depth of about 3 in.

* Crawford M.—Coconut poonac as a food for livestock. *The Tropical Agriculturist* —March, 1940.

PREVENTION OF DAMAGE TO YOUNG RUBBER BY SNAILS AND SLUGS

H. W. R. BERTRAND.
GOVINNA ESTATE, GOVINNA

SINCE Meta became unobtainable, damage to young rubber by slugs and snails has been rather serious on some estates. Hand picking and other methods have been resorted to but have proved either very expensive or ineffective. The Conductor of an estate managed by the writer thought of a scheme which has since been somewhat improved on and has proved absolutely effective, cheap and safe.

Coir fibre from an old mattress was tied in a small bunch round the stem at a height of a few feet, with most of the "fuzz" pointing downwards. This warded off most attacks, but in a few cases the pest got past. A suggestion subsequently made by Mr. W. R. Thomson of British Fertilisers, Ltd., that coconut "bristle fibre" might be used with better effect was tried out with material kindly supplied by him, some two or three ounces per plant being used according to the size of the stem. Doubtless, with practice in tying, an even less amount would be wanted. The bristles are tied more or less about the middle, with the lower ends projecting downwards and outwards. Both on this estate where it was first tried, and subsequently on another which the writer "visits" and where much damage was being done, the method has proved 100 per cent. effective. Obviously the bundles should not be tied too tightly nor with too strong fibres. With bristle fibre quoted at Rs. 8 per cwt. the cost, including labour, would be between $1\frac{1}{2}$ and $2\frac{1}{2}$ cents per plant according to size. The cost per acre would usually be very small as attacks are generally confined to certain areas or even to individual plants.

The method would appear to be applicable to certain other plants of economic or ornamental value.

DEPARTMENTAL AND OTHER NOTES

INCREASING THE CROPS FROM CEYLON RUBBER ESTATES*

INTRODUCTION

ONE of the most serious economic consequences of the war situation in the Far East is the interference, actual and potential, with the availability of rubber to the Allied Powers. At the time of writing, the industry in Malaya has been largely immobilised and there is a serious threat to the Netherlands East Indies. It is obvious that Ceylon, with its relatively small planted acreage, cannot make up more than a very small proportion of the lost production, but it is equally clearly a patriotic duty, as well as good business, for all producers in this country to take such steps to effect an immediate increase in output as may be compatible with the preservation of the capital value of their properties. A notice circulated by the Rubber Controller, dated December 28, 1941, has already drawn attention to this matter.

Hevea possesses remarkable reserves of capacity for the production of rubber, and yields can be immediately increased by adopting measures which are known to be more or less harmful to the tree. Damage caused by the extraction of latex, however, is only a matter of degree. The very operation of tapping invloves artificial disturbance of the normal metabolic processes, and as a broad generalisation it is true that any increase in the yield of latex is accompanied by a reduction in vegetative growth. In the present emergency there is ample justification for drawing on the capital reserves of the tree provided the damage of a direct nature, *e.g.*, tapping wounds, Brown Bast, is not excessive.

The purpose of the following notes is to discuss the more legitimate ways and means of increasing crop, that is to say, the methods which will cause the least injury to the trees. Some may find application on one estate and some on another, and the action that may be taken in any particular area must be left largely to the discretion of the Superintendent. Unless otherwise stated the remarks apply only to mature seedling trees ; a special paragraph is devoted to the tapping of budded areas.

* Rubber Research Scheme, Ceylon, Advisory Circular No. 16.

TAPPING INTENSITY

The most obvious way of boosting the crop is to increase the intensity of tapping, either by increasing the total length of tapping cut (or cuts) or by reducing the interval between successive tappings. The least estates can do at the present time is to tap at 100 per cent. intensity, *e.g.*, S/2, d/2 ; 2S/2, d/4, &c., if their present system is milder. On estates in the wetter low-country districts which have satisfactory bark reserves we recommend the temporary adoption of Double-Three tapping (2S/2, d/3, 133 per cent.) *i.e.*, two opposite half spiral cuts every three days. Attention was drawn to this system in the Fourth Quarterly Circular for 1940 under the heading "Planting Notes", and again in the Third Quarterly Circular for 1941 in the paper entitled "Some Wartime Problems of the Rubber Industry". For details the reader is referred to these two publications, but it may be stated here that in a tapping experiment on Dartonfield this system has given 17 per cent. more rubber over a period of four years than normal alternate day tapping (S/2, d/2, 100 per cent.), and 10 per cent. more than Double-Four (2S/2, d/4, 100 per cent). This method of tapping was adopted on a number of estates in 1941 and although no comparative data are available the impression has been gained that most Superintendents are satisfied with the extra crops harvested.

Another system which has given promising results in the Dartonfield experiment involves tapping the tree on a half spiral on alternate days but on alternating sides *i.e.*, the tree is tapped on alternate days and each cut once in four days. The designation of this system is S/2, d/2, (2 × 2d/4), 100 per cent. Over a period of four years an apparent gain in yield of 9·5 per cent. over S/2, d/2, 100 per cent. has been obtained, though the reliability of this difference is rather uncertain.

At the present time we do not recommend the adoption of any system with an intensity of more than 133 per cent.

In areas of improved high-yielding material, whether buddings or seedlings, it is inadvisable to tap at more than 100 per cent. intensity on account of the greater danger of inducing a high incidence of Brown Bast.

A common method of increasing the intensity is to "double-tap", *i.e.*, tap in the afternoons as well as the mornings. With systems of 100 per cent. intensity or less this procedure is thought to be quite justified, even in normal circumstances, after a long wet period when tapping has been intermittent owing to rain. In such circumstances double-tapping is merely an effort to restore the theoretical intensity of the system by making up for lost tapping days. It should not, however, be carried out for more than a few consecutive days. When good tapping weather can be expected to persist, *i.e.*, in December

or January, it is suggested that an extra tapping be interpolated once in four or five days. Resort to this expedient is inadvisable if the intensity of tapping exceeds 100 per cent. *e.g.*, Double-Three (2S/2, d/3, 133 per cent).

DEPTH OF TAPPING

There is a tendency for tapping in Ceylon to be rather shallower than in Malaya and the N. E. I., and an immediate increase in yield could be obtained by tapping deeper. The aim should be to leave 1 mm. of cortex rather than 1½ mm., which is thought to be about the average on estates in this country. The implications of advocating deeper tapping at the present time when supervision is much reduced are fully realised, and it must be for each individual Superintendent to judge whether his tapping depth can be improved without the risk of serious wounding.

Extra deep tapping is inadvisable on double-cut or full spiral systems owing to the resultant increase in the "ringing" effect.

THICKNESS OF SHAVINGS

A recent experiment on budded trees at Nivitigalakele showed that with the Michie-Golledge knife there is no advantage in taking shavings thicker than 1.25 inch on the S/2, d/2, 100 per cent. system. This corresponds to an average monthly consumption of about ½ inch. The results may be presumed to apply to seedling trees also, but they must be qualified by stating that the tapping, being under close supervision, was of a very high-class. Less expert tappers might advantageously consume more bark. It is necessary of course, to take rather thicker parings where the interval between successive tappings is three or four days.

The following annual rates of bark consumption are considered to be minima for the production of maximum crop in the wet zone. They assume the cessation of tapping for one month covering the wintering period. In drier districts the consumption should be slightly higher, both on account of the larger number of tapping days and the fact that the cortex dries out more between tappings.

S/2, d/2, 100 per cent.	..	5½ inches	
2S/2, d/4, 100 per cent.	..	6½ ,,	(*i.e.*, 3¼ inches on each panel)
2S/2, d/3, 133 per cent.	..	8 ,,	(*i.e.*, 4 inches on each panel)

In this connection attention may be drawn to the necessity of keeping the knives sharp. Maximum production cannot be obtained with blunt knives.

HEIGHT OF CUT

It is well known that the yield of seedling trees increases markedly as the height of the cut decreases. Where tapping

is on a single half spiral cut with a change of panel every 6 or 12 months, this fact can be utilized by tapping the lower panel of every tree irrespective of the normal change-over. This practice will inevitably lead to a period of reduced crops in later years when all the higher cuts come to be tapped, but this is a small price to pay for the satisfaction of maximum output in the present emergency.

UNPRODUCTIVE TREES

On every old estate which has not been rigidly and recently thinned there is a certain proportion of trees which are out of tapping on account of Brown Bast, temporary dryness or thin bark. Lazy and unambitious tappers will be content for these trees to be permanently out of commission and will, unless carefully supervised, add to their number. Every effort should be made to bring such trees back into tapping even at the expense of making wounds on trees which are difficult to tap on account of irregularities in the panel. It would, however, be unsound to allow tappers to waste time on trees with a negligible yield at the expense of earlier and more careful tapping of productive trees.

Where the bark of any panel is too thin to be tapped at normal levels it is suggested that a new cut should be opened at the maximum height at which the tapper can operate without a ladder. With the Michie-Golledge knife this is about 40 inches for a man of average stature on flat ground. The bark at this height will usually be virgin and of adequate thickness. In the case of a double-cut system, trees with thin bark on one panel can thus be tapped on both sides, but if the bark at normal levels is untappable on both sides then the new high cut should be tapped on one side only, *i.e.*, no tree should be tapped with two high cuts.

SCRAP

When crops were restricted the poorer grades of scrap were usually left on the trees or on the ground, but in present circumstances all grades should be collected. As an indication of the quantity of scrap that can be harvested if adequate payment is made, the following figures relating to the last three years' crop at Dartonfield may be of interest. The tapping system over most of the estate is 2S/2, d/4, 100 per cent.

Average yield per acre.. ..	529 lb.
,, scrap ,, ,, ...	67 ,,
,, ,, as per cent. of total ..	12·6

SIZE AND ALLOCATION OF TAPPERS' TASKS

Within limits the yield per acre varies inversely with the size of the tapping task. A measure of the increase in crop obtainable by reducing the task was made in a series of experiments

by Mr. A. H. Healey and published in the First Quarterly Circular for 1940, page 19. The full task consisted of 180 trees tapped on the Double-Four system (2S/2, d/4, 100 per cent.) on flat land. It was estimated that by reducing the size of the task by 30 per cent. *i.e.*, to 126 trees, the annual crop would be increased by 6·7 per cent.

Unfortunately a decrease in the size of the tapper's task automatically involves an increase in the number of tappers (if the system remains unaltered) and extra tappers may not be obtainable. Where tapping is on a single cut system this difficulty may be circumvented by changing to a double-cut system. For example, a task of 200 trees on S/2, d/2, 100 per cent. may be changed to 100 trees on 2S/2, d/4, 100 per cent. without any alteration in the tapping force. The latter, although consisting of the same number of cuts, will be tapped in less time than the former, and a higher intake due to an earlier average time of tapping may be confidently anticipated. In the S.-W. Monsoon, when partial wash-outs are frequent, more latex can be collected in a scramble from 100 trees with two cuts each than from 200 trees with one cut.

In tapping experiments in the wet zone the Double-Four system (2S/2, d/4, 100 per cent.) has consistently given slightly higher yields than half spiral alternate day tapping (S/2, d/2, 100 per cent.), but it is not suited to the drier localities.

A further legitimate method of increasing yields is to allocate the best tappers to the highest yielding tasks. An example of the advantage to be gained by thus disposing the tappers is given below. Consider two tasks X and Y and two tappers A and B. When tapped by the better tapper A, task X gives 12 lb. and task Y 6 lb. Tapper B is only able to harvest two-thirds the crop that can be obtained by A. The total yields obtained under the two alternative arrangements are given below, and it is seen that the first arrangement results in an increased crop of about 14 per cent.

	Task	Tapper	Yield	Task	Tapper	Yield	Total
(1)	X	A	12	Y	B	4	16 lb.
(2)	X	B	8	Y	A	6	14 ,,

ABSENTEE TAPPERS

It is, perhaps, elementary to point out that crop is lost unless extra tappers are available to fill tasks which would otherwise remain untapped in the occasional absence of regular tappers. The employment of substitute tappers is not favoured by some Superintendents as it increases the difficulty of maintaining a uniformly high standard to tapping, but in present circumstances extra crop is more important than a few wounds.

REST DURING WINTERING PERIOD

At first sight an obvious method of increasing crops is to omit the usual period of rest during refoliation after the annual "winter". This practice, which is almost peculiar to Ceylon, was originally based on sound physiological considerations, but there are no experimental data relating to this country to show whether the total annual crop is thereby increased or decreased. In other countries the advantages of a rest are not considered to compensate for the loss of crop during this period, but in a normal season in Ceylon the yield appears to show a more marked decrease than elsewhere, probably because the wintering is more regular. In the absence of definite information the value of continuing to tap throughout the wintering period must remain a matter of opinion, and the view here expressed is that it would be inadvisable to add this burden to all the other measures designed to extract the maximum quantity of latex from the tree.

It is suggested, however, that the period of rest might be reduced to two or three weeks by continuing to tap about a week longer than usual, *i.e.*, until most of the trees are bare or starting to show new leaves. On physiological grounds the time at which tapping should be stopped is during *re*-foliation rather than *de*-foliation, and the impression has been gained that some estates stop tapping rather too early. In normal times an important consideration is the economics of collecting reduced crops, but in the present emergency it is the rubber itself which is of first importance even if it is expensive to collect. To some extent trees might receive individual treatment, *i.e.*, tapping of late-wintering trees might be continued longer than the rest and early winterers taken back into tapping before the remainder.

YOUNG BUDDED AREAS

Although all budded areas should be brought into tapping as early as possible we do not encourage any departure from normal methods, nor is it considered advisable to tap trees before they have attained the minimum girth of 20 inches at a height of 36 inches from the union. The only modification of our standard recommendations of which we would approve is to tap areas with only, say, 60 per cent. of tappable trees as against the usual figure of 75 per cent.

REPLANTING

In present circumstances it is both poor business and, in our opinion, a dereliction of national duty to cut out tappable trees for replanting unless they have been ruined for future yields by "slaughter" tapping. Taking the long view, the desirability of accelerating replanting programmes in Ceylon is

not diminished, and reserves, both of cash and planting material, should be built up against the day when work can be resumed. Reserves of planting material may take the form of stumped buddings which can be developed in nurseries and transplanted when about two years old from budding. An experiment at Dartonfield has shown that stumped buddings can be tapped nearly a year earlier than budded stumps planted at the same time, and it is believed that the method may be of considerable value in making up for time lost by the interruption of replanting programmes.

SUPERVISION

It is necessary to record our opinion that the success of the various measures suggested above is largely dependent on the maintenance of efficient supervision. The reduction of European Staffs consequent on military embodiment, and the restrictions imposed by petrol rationing, will render this difficult to achieve, and it can only be suggested that Superintendents should regard the supervision of tapping as the first call on their time even to the detriment of work in new clearings.

Research Laboratories,
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January, 1942.

SUGAR CANE SOILS, MANURING AND IRRIGATION IN CERTAIN PROVINCES OF INDIA.*

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INTRODUCTION

IN this section a summary of information obtained on sugar cane soils, irrigation and manuring as a result of visits to certain sugar cane areas and experimental centres in India is furnished. The conditions and problems of sugar cane cultivation are so extremely varied in the different Provinces that it is well nigh impossible, in a few pages, to deal with the subject adequately. As, however, but few of the planting practices and experimental findings in India will be applicable to local conditions without test, a detailed presentation of the facts would be of little practical interest and value. Attention would therefore be directed mainly to the general aspects of the subject under review. A brief discussion of the possibilities of sugar cane cultivation in Ceylon, so far as it relates to the particular aspects of study referred to, will be included. References will also be made to *gur* (jaggery) and *khandsari* (unrefined) sugar manufacture, and to the experimental technique relating to field trials with, and the analytical examination of, sugar cane.

The sugar cane centres, factories, and research stations visited in the course of the tour were :—

The Coimbatore Sugarcane Research Station,
Hebbal and Irwin Canal Farms, Mysore,
Hadapsar Effluent Farm, Deccan, Bombay,
Padegaon Sugar Cane Research Station, Deccan,
The Sansar Sugar Factory, Kalamb, Deccan, Bombay,
The Agricultural College, Lyallpur, Punjab,
The Imperial Institute of Sugar Technology, Cawnpore, U. P.,

*Extract from a report made in January 1941 by the author on a tour in India to study the problem of alkali soils. An extract from the same report was reproduced in *The Tropical Agriculturist*, October, 1941.

The Shahjahanpur Sugar Cane Research Station, U.P.,
The Pusa Agricultural Research Institute, Bihar,
The Sugar Cane Research Sub-station, Patna, Bihar,
The Plassey Sugar Factory and Farm, Ramnagar, Bengal.

SUGAR CANE CULTIVATION IN INDIA—GENERAL

The total area under sugar cane in India during the 1940–41 season exceeded 4·5 million acres. Of this extent, about 55 per cent. or over 2·5 million acres were cultivated in the United Provinces alone. The Punjab and Bihar followed with over 500,000 acres each. The other cane-growing Provinces in order of production were Bengal, Madras and Bombay with a total acreage of 650,000 acres.

The rainfall of sugar-growing areas in India varies from 20 inches and less to over 80 inches. The greater part of the crop is irrigated by canal or tube well irrigation. In the U. P. 40 per cent of the crop (over 500,000 acres) is, however, unirrigated; in north Bihar, with an annual rainfall of about 40 inches, the crop is grown with no irrigation whatsoever. In the Bombay and Madras Presidencies and Mysore cane is grown entirely under irrigation which is freely given, while in the Punjab, Bengal and the U. P. the quantity of irrigation water supplied per acre is relatively small. The duty varies from 2 to 3 acre ft. per acre per crop, as in the U. P., to over 12 acre ft. per acre as in the Bombay Presidency.

The soils of the sugar cane areas of India are mainly alluvial silts and loams, *e.g.*, those of the U. P., Punjab, North Bihar, and parts of Bengal and Madras Presidency; but residual soils such as the red loams of Mysore, Bengal and Madras Presidency and the black and grey brown clay loams of the Deccan, Bombay, S. Bihar, and other parts of India are also utilized for the crop with success. On some of the latter soils, however, the problem of soil drainage requires careful attention, as sugar cane is a crop which is very susceptible to waterlogging. The soils are generally well supplied with calcium and potash, but are deficient in nitrogen and organic matter, and to a lesser degree, in phosphoric acid.

Manuring of the cane crop is, therefore, universal in India. In addition to farmyard manure, green manure, compost, and organic cakes, artificial fertilizers are used in large quantities. Nitrogen is the chief fertilizing constituent required by the crop, and the amounts of this constituent applied vary from 40 to 400 lb. per acre. In tropical India *i.e.*, Mysore, Madras, Bombay, where thick and relatively long-aged varieties are grown and irrigation is heavy, much larger quantities of nitrogen are applied than in the sub-temperate Provinces, *e.g.*, Punjab. Phosphoric acid and potash are not generally

applied, as the responses to these fertilizing constituents are small. In certain parts of the Bombay Presidency, Mysore, Bihar and Bengal, however, phosphoric acid has proved beneficial and is given at the rate of 40–50 lb. per acre as superphosphate or nicifos.

Sugar cane is generally grown in rotation with other crops in India, paddy being the most popular of these. Wheat, kurakkan, cambu, sorghum, tobacco, cotton, jute, legumes, *e.g.*, gram, and sunnhemp, and other green manures are among the other crops included in the rotation. Plantains and betel are occasionally used for the purpose in the Madras Presidency.

Ratooning of sugar cane is fairly common in certain Provinces, but is generally discouraged, and precluded in a few areas, *e.g.*, Mysore, by controlling the irrigation water issue. Where ratooning is practised, one ratoon crop is generally taken, but occasionally the crop is ratooned for as long as 5 years.

Methods of cultivation vary widely in the different Provinces and even within a Province, being dependent to some degree on the type of cane cultivated. The Java method of cultivation in trenches is adopted in parts of Bengal, and the Madras Presidencies, the trenches being about one foot in depth. In the Bombay Presidency, Mysore, and other areas planting in furrows followed by earthing up later is generally the practice. Sowing on the flat with or without earthing later is adopted in the Punjab, Bihar, parts of the U. P., &c. Earthing up is essential on the richer soils to prevent lodging. Where this is impracticable, binding the tops of canes and leaves is practised. The spacing between rows varies from 1 to 4 ft. and is determined by the type of cane grown, method of cultivation, fertility of the soil, &c.

Average yields of well-cultivated crop in India vary from about 25 tons of cane per acre in the U. P. and Bihar to over 50 tons in parts of the Bombay and Madras Presidencies. Yields are determined by the variety, soil and cultural conditions, and the frequency and amount of irrigation water. In the U. P., Punjab and other parts of sub-tropical India early maturing varieties are generally cultivated owing to the danger of damage to the crop by frost.

Sugar cane is utilized in India for the manufacture of *gur* (jaggery), *khandsari* (unrefined) sugar, and refined sugar. The greatest development of the cane sugar industry in all its aspects is in the U. P.

SOILS

In the following paragraphs the soils of the areas visited are dealt with separately.

Coimbatore.—In Coimbatore sugar cane is grown on red and brown calcareous loams formed from the decomposition of igneous rocks and gneisses. "Kankar" or massive limestone underlies the soil at varying depths. Gypsum is often present in the soil profile. Provided the drainage is good, both the red and brown soils are very suitable for the crop.

Mysore.—In Mysore the soils on which sugar cane is grown are mainly the red, yellow and grey loams of 2 to 3 ft. depth, derived from igneous rocks and gneisses. These constitute about 50 per cent. of the 50,000 acres of irrigable land under the Irwin Canal. They are very deficient in nitrogen, the amount varying from 0·02 to 0·04 per cent. in the majority of the soils, and in organic matter, and are poor in phosphoric acid and bases. Their pH values generally vary from 6·5 to 7·5. About 40 per cent. of the irrigable area under the Irwin Canal is too gravelly or stony for the profitable cultivation of cane and 10 per cent. of the land becomes too moist for cane when water flows in the irrigation channels. A small area of cane is also grown on the black clay loams.

Bombay Presidency.—The soils of the cane-growing areas of the Bombay Presidency are mainly derived from igneous rocks, gneisses and schists. They are generally of heavy texture and vary from a few inches to as much as six feet in depth. They are underlain by decomposing rock material known as *murum.* In colour they show a wide variation from grey to brown and black. Eight soil types have been recognized in the Deccan area. These soils are rich in lime, potash and phosphoric acid, but are deficient in nitrogen and organic matter. Some of them have a tendency to water-logging, and need to be carefully drained if the formation of alkali salts is to be avoided. All these soils require intensive cultivation and manuring with nitrogenous fertilizers and bulky organic manures.

Punjab and Bihar.—The sugar cane soils of the Punjab and North Bihar are deep, alluvial silt loams rich in calcium carbonate, the content of which frequently exceeds 10 per cent. They overlie a sand or clay sub-soil. Their chief requirements are nitrogen and organic matter, but they are well supplied with mineral plant foods. They are generally slightly alkaline in reaction. They drain well normally. The soils of South Bihar vary, but comprise largely the black heavy loams derived from the weathering of basic igneous rocks and schists.

United Provinces.—The soils of the main cane-growing tracts of the U. P. are the alluvial loams of the Gangetic plains. These soils do not vary much in chemical composition but are of wide textural range. They are rich in lime and potash, occasionally deficient in phosphoric acid and invariably in nitrogen and organic matter.

Bengal.—Sugar cane is cultivated mainly in W. Bengal. The soils on which the crop is grown are of two main types : (i.) the alluvial soils of the Gangetic plain varying in texture from light to heavy loams, (ii.) the red lateritic soils derived from igneous and metamorphic rocks. The greater part of the crop is cultivated on the former types of soil. These are generally rich in plant food constituents. The red lateritic loams are acid in reaction and respond to liming. They are deficient in phosphoric acid and, to some degree, in nitrogen.

MANURING

The practices followed in regard to the manuring of cane at the centres or in the areas indicated are as follows :—

Coimbatore Farm.—At the Coimbatore Farm on the red and brown loams, in addition to a basal application of farmyard or green manure, sugar cane is manured with nitrogenous fertilizers at the rate of 100 lb. nitrogen per acre, half being in the form of organic cake and half as sulphate of ammonia. In other parts of the Madras Presidency, *e.g.*, at the Gudiyattam Sugar Cane Research Station, the normal manure application per acre is ; 10 tons farmyard manure at the time of preparation of the land, 2 cwt. superphosphate and 75 lb. nitrogen (in the proportion of two of sulphate of ammonia to one of groundnut cake) at planting, and an equal quantity of nitrogen at the time of earthing up. The varieties of cane cultivated are the Coimbatore strains.

Mysore.—In Mysore sugar cane is heavily manured, particularly with nitrogenous fertilizers, the quantity of nitrogen applied being as much as 400 lb. per acre. Of this amount, 60 lb. is applied in the form of green manure *e.g.*, sunnhemp, before planting, 100 lb. as compost or farmyard manure at planting and when earthing up, and 240 lb. as sulphate of ammonia, in equal amounts at planting, 6 and 12 weeks later, and subsequent to earthing up. In addition, $1\frac{1}{2}$-2 cwts. concentrated superphosphate and, occasionally, 1 cwt. of sulphate of potash are applied in the furrows at the time of planting. After earthing up, the Java "cone" method of applying fertilizers is employed on Departmental Farms. Holes are made in the ridges 2–3 inches apart with the cone and the requisite quantity of fertilizer mixture applied to each hole with a standard measure. Yields of crop obtained are from 35–50 tons/acre, the variety commonly cultivated being H. M 320, a 12–13 month cane. This variety does not deteriorate in quality for 2 to 3 months after maturity.

Bombay Presidency.—At the Hadapsar Experimental Effluent Farm, nitrogen is applied to sugar cane as sewage at the rate of 225 lb. per acre. The effluent contains 2·8–3 p.p. 100,000

of total nitrogen of which 1·2 parts are as free and saline ammonia and the remainder as albuminoid nitrogen. In addition, the leguminous crop *dhaincha* (*Sesbania aculeata*) is cultivated for green manuring, the green material thus obtained being about 10 tons per acre. Experience has shown that it is very essential to stir the soil treated with the effluent frequently, if it is to be kept in good condition. 1,000 acres of cane are irrigated with effluent in the area, the irrigation rate being Rs. 72 per acre for a 15-month crop. Yields of cane on the farm average 42 tons per acre, the variety chiefly cultivated being Co 419.

At the Padegaon Sugar Cane Research Station on the heavy black, brown and grey loams, the following are the recommendations at present in regard to the manuring of the crop :—

(1) Green manure or compost to be applied at the rate of 10 tons per acre ; if the latter, half is to be ploughed in and half applied in the furrows.

(2) Top dressings of nitrogen at the rate of 300 lb. per acre for plant cane in the proportion of one of sulphate of ammonia to two of organic cake, *e.g.*, groundnut cake, are to be given as follows :—

At planting : 30 lb. nitrogen as sulphate of ammonia,
Two months later : 30 lb. as sulphate of ammonia and 75 lb. as cake,
Four months from planting : 40 lb. as sulphate of ammonia,
At earthing : 125 lb. nitrogen as cake.

Yields of crop obtained vary from 45 to 50 tons per acre. Some of the varieties now normally cultivated are Co 419, Co 360, and POJ 2878.

Punjab.—Early-maturing varieties only are cultivated in the Punjab. Manuring is chiefly with nitrogenous fertilizers at the rate of 100 lb. of nitrogen per acre as castor cake. This is given in two applications : the first after planting and the second before the rains about 4 months later. In addition, farmyard manure at the rate of 5 tons per acre is given as a basal dressing. Potash and phosphoric acid are not effective in increasing yields. Yields of crop on Departmental Farms vary from 30 to 35 tons per acre, but the average on cultivators' fields is about 25 tons per acre. Some of the varieties cultivated are Co 285, Co 312 and Co 313.

United Provinces.—The main fertilizing constituent required by cane on the alluvial soils of the U. P. is nitrogen. There is no response generally to applications of phosphoric acid and potash, but occasionally phosphoric acid gives beneficial

returns. The quantity of nitrogen applied varies from 100 to 150 lb. per acre, 60 lb. being in the form of green manure and the balance as organic cake and sulphate of ammonia. Where artificials are not normally used, farmyard manure at the rate of 10 tons per acre is applied at the time of preparation of the land. At the Shahjahanpur Sugar Cane Research Station molasses have been found to give increased crop yields, but owing to the disadvantages attendant on its usage, *e.g.*, difficulty of handling, its relatively high cost, it has not proved economic to utilize it for the purpose. At Padegaon, Bombay, Deccan, molasses alone have not proved effective in increasing yields, but mixed with *gurhal* ash, beneficial results have been obtained. The average yield of crop on the Shahjahanpur sugar cane station is 30 tons per acre, but the average for the province is only from 20 to 25 tons per acre. Yields can be increased to 50 tons per acre by heavy manuring, but the practice is not recommended. Varieties chiefly cultivated are Co 312 and Co 421.

Bihar.—On the alluvial soils of N. Bihar, where again short-aged varieties of sugar cane are grown, the quantity of nitrogen applied as top dressings to sugar cane is comparatively small, *viz.*, 40–60 lb. per acre. This is given in organic and inorganic form, and is additional to a basal application of green manure (sunnhemp) or farmyard manure which is reckoned to give about 60 lb. of nitrogen per acre. Phosphoric acid is invariably applied at the rate of 40–50 lb. per acre in the form of superphosphate or nicifos. The fertilizer mixture is given in two dressings, half at planting and half at earthing. Sugar cane press mud is recommended for application to cane at the rate of 4 to 7 tons per acre, about 10 to 12 weeks before planting. Yields of crop in Bihar average about 20–25 tons per acre. No irrigation water is normally given in N. Bihar and this may partly account for the relatively low yields. The crop varieties popularly cultivated are Co 331, Co 313 and Co 299.

Bengal.—On well-cultivated sugar cane plantations on the alluvial silt and loam soils of Bengal, nitrogen is applied to the crop at the rate of 100–125 lb. per acre partly as a basal dressing of green manure or farmyard manure and partly as top dressings of castor, groundnut or mustard cake mixed with sulphate of ammonia or nicifos. The green manures cultivated are sunnhemp, *dhaincha* (*Sesbania aculeata*) or cowpea. When cattle manure is used half is applied when the land is being ploughed and half in the furrows. Phosphoric acid is applied at the rate of 30–50 lb. per acre as bone meal or nicifos. The fertilizers are given in three dressings, two before and one at earthing up. Yields on these soils average 30–35 tons/acre for plant cane and 20–25 tons/acre for the ratoon crop. The varieties

cultivated are mainly Co 213, Co 313 and Co 421. On the red lateritic soils of N. Bengal liming at the rate of about 10 cwt. per acre has proved to be very effective.

IRRIGATION

In tropical India, *e.g.*, the Bombay and Madras Presidencies and Mysore, sugar cane is heavily irrigated, the duty being as high as 12 acre ft. per annum exclusive of rainfall. In parts of sub-tropical India where irrigation facilities are available, the crop is watered during the dry season but in restricted quantities. Thus in the U. P. the maximum number of irrigations per season each of 3 to 4 acre-inches per acre is six, the total duty being less than 2 acre ft. per acre. The irrigations are given during critical periods at intervals of a fortnight to a month. In the Punjab the number of irrigations varies from 16 to 20, and the interval between irrigations from 10 to 15 days. The total duty per season is 5 to 6 acre ft. per acre. In Bengal on one large plantation in Ramnagar, where the annual rainfall is 55–60 in. only one or two irrigations are given during the dry season. In other parts of sub-tropical India, *e.g.*, North Bihar, parts of U. P. and the Punjab, the crop is almost entirely cultivated without irrigation. This is due to the high water-retentive capacity of the soils, the absence of irrigation facilities and a comparatively higher and better distributed rainfall (42 to 55 inches per annum). The crops in these areas show, however, marked responses to as few as two or three irrigations during the hot weather.

In the tropical sugar cane districts of India, where the rainfall is generally low (about 20 inches per annum), irrigation is regularly practised, the interval being, on the average, once in 10 days, or more frequently at certain periods. At the Padegaon Sugar Cane Research Station in the Bombay Presidency, experiments carried out with varying duties of water showed that, exclusive of rainfall, 8 acre ft. per annum at field site was the optimum. Presuming a loss of 30 per cent. in transit, a duty of 120 in. of irrigation water at distributary head was required. The yield obtained with normal manuring and cultivation and the irrigation duty indicated was 45–50 tons per acre for a 14-month crop. The duty fixed by the Irrigation Department for sugar cane in the Deccan Canal areas is 124 inches per acre per annum.

Where heavy irrigation is given, as in Mysore and Bombay, at the early stages of cultivation of the crop the irrigation water is let into the furrows in zig–zag fashion. After earthing, the water is circulated likewise between the rows. Where the crop is not earthed, the fields are divided into small plots by shallow drains which thus carry the water over the whole field.

THE POSSIBILITIES OF SUGAR CANE CULTIVATION IN CEYLON

As this question has been comprehensively dealt with in the report of the Committee appointed by the Hon'ble the Minister for Agriculture and Lands, of which the writer was a member, no further comment is required except to indicate that (1) there are comparatively large extents of soil in Ceylon suitable for the crop. These soils are similar to the Mysore and Bengal red loams, but are relatively richer in plant nutrients than the latter. They would, however, require systematic manuring, particularly with nitrogenous fertilizers, if good yields are to be secured over a period of years; (2) as the crop, if cultivated on any large scale, would need irrigation during the dry weather, owing to the low water-retentive capacity of our soils and tropical red soils generally, experiments would have to be conducted to determine the optimum water requirement on different soil types under varying manurial treatments.

ANALYTICAL AND FIELD EXPERIMENTAL TECHNIQUE

Methods of Analysis.—The methods adopted in India for the analysis of sugar cane and its products are those detailed in "A Handbook for Cane Sugar Manufacturers and their Chemists" by G. L. Spencer and "Methods of Chemical Control for Cane Sugar Factories and Gur Refineries" issued by the Sugar Technologists' Association of India.

Sugar Cane Sampling for Analysis.—At the centres visited, a sample of sugar cane for analysis consists of from 30 to 75 canes taken at random from 6 to 7 clumps. When samples are required from randomized experimental plots, the clumps are selected from the border rows. The canes are crushed in a bullock or electrically-driven crusher after the unmillable tops have been removed. The juices are strained and weighed. When new varieties are being tested out, each sample consisted of the canes from a single clump.

Analyses commence when canes are eight months old at Coimbatore, in Bihar and the U. P. and when ten months old in Mysore, and are continued up to the thirtieth month. Monthly and, at certain stages, fortnightly analyses are carried out.

Tests for Maturity.—At Pusa, the Q1/Q2 ratio (an extension of the top/bottom ratio of Visvanath and Kasinath) is used to determine the stage of maturity in cane, Q1 being the Brix of the third or fourth internode below and Q2 the Brix of the fourth internode above the central internode, as determined by the hand refractometer. Regression equations have been worked out for determining the Brix value of the juice of the whole cane without crushing the stalk.

Experimental Field Technique.—The plot dimensions for field experiments with sugar cane vary somewhat at different experimental centres, but the nett harvested plot area is generally 1/40th of an acre (1 *guntha*), the gross area being about 1/28th acre. The plot is at least three times as long as it is broad. The number of harvested rows is 5 or 6 when the rows are spaced 3 ft. apart, and the length of the rows varies from 60–72 ft. The Statistician of the Pusa Research Institute, however, recommends that the nett harvested plot should consist of 4 rows each 90 ft. long, 2 rows at either side and a length of 6 ft. at the ends of the rows being left as a border.

SUGAR AND JAGGERY (GUR) MANUFACTURE

Refined sugar was manufactured in 147 factories in India during 1940–1941, about 50 per cent. of which were in the U. P., and 25 per cent in Bihar. Research in sugar technology is carried out at the Imperial Institute of Sugar Technology, Cawnpore. Here a complete experimental factory unit to deal with a ton per hour of sugar cane has been erected to study the research problems connected with cane sugar manufacture and the utilization of the by-products of the industry. Courses in sugar technology are also conducted at the Institute. In the U. P. and Bihar, *khandsari* or unrefined sugar is extensively manufactured as a cottage industry in small mills distributed over the planted areas. The process of manufacture is briefly as follows :—The juice is boiled in a special furnace after neutralization with lime if necessary, and clarification with superphosphate solution and *bhindi* mucilage prepared by soaking overnight 1 part of crushed *bhindi* (ladies' fingers) plant in 10 parts of water and squeezing the soaked plant. The striking point of the "rab" or concentrated juice is ascertained by a simple instrument called the "rabometer". At the proper concentration the "rab" has a Brix value of 85–87. The "rab" is then poured into cooling pans, (a little sodium hydrosulphite being added at the same time to bleach the product) and allowed to crystallize for 7–10 days. The rab is then centrifuged in a power drawn centrifuge. Trials made in this laboratory with the clarificants mentioned have confirmed their value for the preparation of jaggery of good keeping quality from kitul (*Caryota urens*) toddy.

All over India much attention has been given to improvements in *gur* (jaggery)-making outfits. A bulletin on this subject has been issued by the Sugar Committee of the Imperial Council of Agricultural Research, New Delhi.

In Mysore and the Madras Presidency much attention has been given to the manufacture of activated carbon from paddy husk with the primary object of utilizing it for decolourizing

cane juices and so obtaining a superior quality of jaggery (*gur*). The material is also useful in the oil-refining industry and in the preparation of gas masks. Two methods of manufacture have been adopted: (1) the carbonization process followed by alkali and acid treatments. This is described in leaflet No. 81 of the Department of Agriculture, Madras—"Manufacture of Active Carbon from Paddy Husk", (2) the zinc chloride-hydrochloric acid process. Recently at the Bilari Research and Testing Station, U. P., where research on *gur* and *khandsari* sugar manufacture is being carried out, a process has been worked out for the preparation of activated carbon from the same raw material using calcium chloride as the activating agent. At this station too, a complete unit, which includes a crusher (*Kolhu*), furnace (*bel*), crystallizer, hand centrifuge, and sugar drier, has been designed for the manufacture of sugar on a cottage industry scale. The cost in India of one such unit is reckoned at Rs. 750. Such a unit, even at double the cost, should prove very suitable if it is intended to establish a cane sugar cottage industry in Ceylon.

At Mandya Farm a new type of white jaggery is prepared which is very much like sugar. The juice, after liming and treatment with activated carbon obtained from paddy husk in the proportion of 1 lb. of the latter to 100 gallons of juice, is boiled in the usual way in a shallow pan (about 8 in. to 1 ft. deep) to a temperature of about 116°–118°C, *i.e.* about 2°C less than that for jaggery. The pan is removed from the fireplace, the contents allowed to cool slightly, and then stirred rapidly with a wooden stirrer till the jaggery begins to grain. A creamy-white product of good keeping quality is thus obtained.

UTILIZATION OF BY-PRODUCTS

Molasses in the chief by-product of the cane sugar industry. At the Mandya factory in Mysore and in a few others in U. P. and Bihar, a part of the molasses is utilized for the manufacture of power alcohol. The material is also used as a cattle food in various ways, as a manure, for soil reclamation purposes and as a surfacing for roads. At the Indian Institute of Science, Bangalore, attempts are being made to work out a process for the extraction of potash from molasses by treatment with tartaric acid obtained from green tamarind.

At the Sugar Technological Institute, Cawnpore, *begasse* (cane fibre), cane trash, and press mud have been successfully employed for the manufacure of compost by the hot fermentation process. The final product has a nitrogen content of about 1 per cent. In the *khandsari* sugar industry, *begasse* and cane trash are used as fuel.

MISCELLANEOUS

In this brief section will be set down the observations of the writer in regard to work of experimental or practical interest connected with local agricultural or chemical science, and not referred to elsewhere in this report. The original publications in respect of some of these subjects are available for reference, if necessary.

In addition to the centres already indicated, the following were visited :—

The Indian Institute of Science, Bangalore.
The Nutrition Research Laboratories, Coonoor.
The Dry Farming Station, Rohtak, Punjab.
The Ganeshkand Fruit Experiment and Cold Storage Research Station, Poona.
The Guntur Agricultural Station, Madras Presidency.

(1) *Paddy Rotations.*—In many parts of India paddy is not cultivated successively on the same land, but the practice of rotations on paddy land is by no means general. The cultivation between paddy crops of a leguminous crop for food, such as cowpea and grams, or for green manuring, *e.g.* sunnhemp, *dhaincha* (*Sesbania aculeata*) is fairly commonly practised. Sugar cane is perhaps the most popular crop for growing in rotation with paddy. In the Coimbatore District of Madras, paddy is rotated with sugar cane, plantain and betel or turmeric. In Mysore under the Irwin Canal Scheme, the normal rotation practised is sugar cane or cotton, green manure (a mixture of sunnhemp, horse gram and cowpeas), paddy, and kurakkan or cigarette tobacco (Harrison's Special). A rotational system of irrigation or block system of cultivation is adopted in the area, the blocks being of 50 acres maximum extent. In the Sind, U. P., and Bihar, grams, peas, rape seed and leguminous green manure and fodder crops, *e.g.*, berseem clover (*Trifolium alexandrinium*), *matar* (*Lathyrus sativus*) are among the crops cultivated occasionally after paddy. In Bihar and U. P. sugar cane is included in the rotation, in places. Berseem clover is popular in the Punjab between rice crops. At the Chinsura Paddy Farm in Bengal, when early varieties of rice are cultivated a *rabi* (winter) crop of gram or lentils is grown. Jute, sugar cane, potatoes and the green manure *dhaincha* are other crops grown in rotation with paddy in certain areas of the Province.

(2) *The Harrowing of a Broadcast Paddy Crop.*—In many parts of India where paddy is sown broadcast for any reason whatsoever, the practice of harrowing or ploughing a growing crop of paddy when the crop is about 4–6 weeks old is common, as it has been found appreciably to increase crop yields. The practice is adopted in certain parts of Mysore, in the Punjab

Hills, in E. Bengal and Bihar. The implements used are a spiked harrow or a country plough without a mould board, these being generally drawn by bullocks.

(3) *Dry Farming.*—At the Dry Farming Research Station at Rohtak in the Punjab where the annual rainfall is about 15 inches, experiments are conducted to study the problems of dry farming in India. The crops grown in winter are barley, wheat and gram; in summer cambu, cotton, sunflower and green manure crops. The importance of keeping land fallow has been strongly indicated. Increased yields subsequent to fallowing are attributed to: (1) the moisture conserved, (2) the greater availability of the nitrogen and mineral nutrients of the soil as a result of the practice. Moisture conservation is also promoted by (1) the eradication of weeds, (2) artificial mulches of *bajra* (cambu) and cotton stalks and, to a lesser degree, by (3) the formation of a soil mulch. Deep cultivation (6 inches) was not more advantageous than shallow cultivation (4 inches) in conserving moisture. Yields of cambu from plots so treated were not significantly different. The value of the "Sohaga" or levelling beam for breaking clods, levelling plots and improving the tilth of seed beds has also been demonstrated.

At the Agricultural Station, Guntur, Madras Presidency, dry farming is practised with great success. The annual rainfall is only 35 inches, most of which falls during the S.-W. monsoon from June to September. Rain does, however, fall during the south-west monsoon months of October and November. The soils of the district are of two main types: (1) the heavy black clay loams of over 6 ft. depth and high water-retaining capacity. These drain freely. They are well supplied with potash and lime, but are poor in nitrogen and phosphoric acid; (2) the red light loams of poor water-retaining capacity and low nutrient status. The former type of soil predominates. The crops cultivated in the district are cigarette tobacco (Variety Harrison's Special), of which there were 110,000 acres in 1940, chillies, groundnut, cotton, dry grains, dhal and fodder crops. There are two main seasons for cultivation: (1) the wet or S.-W. monsoon season (*punasa*), (2) the N.-E. monsoon or partially dry season (*pyru*). In the former, groundnut, fodder and the minor food crops are cultivated, and in the latter, tobacco, cotton, chillies and millets. It will be noted that the more important crops are not cultivated during the heavy N.-E. rains, but immediately following them. The high water-retentive capacity of the black soils enables them to satisfy adequately the requirements of these crops for water during the subsequent cool, dry months (December to February) which

are ideal for the ripening and harvesting of the crops, and the preparation of the produce for storage or sale.

The system of rotation practised, which has been found best for the district, is as follows :—

1st year ..	1st season (June-September)	Groundnut and dhal in rows, cambu and Italian millet broadcast ; or fodder
	2nd season (October-March) (if favourable)	Maize and sorghum for food and fodder ; or fallow
2nd year ..	1st season ..	Fallow
	2nd season ..	Chillies
3rd year ..	1st season ..	Fallow
	2nd season ..	Sorghum
4th year ..	1st season ..	Fallow
	2nd season ..	Tobacco or cotton

Generally only one crop is taken each year. If the N.-E. monsoon is favourable, a second crop may be taken. Like elsewhere, it is the distribution of the rainfall rather than the quantity which matters. Inter-cultural operations are very essential for success. Good yields of crop are obtained in normal seasons. Thus yields of cigarette tobacco average 750 to 1,000 lb. per acre. No artificial fertilizers are generally applied, but cattle manure is widely used, even tobacco being given a dressing of $1\frac{1}{2}$ to $2\frac{1}{2}$ tons per acre. The leguminous fodder *Phaseolus trilobus* (*pillipesera*) grows excellently in the area and is sown either as a pure crop or mixed with sorghum.

(4) *Middle Class Land Colonization in Mysore.*—An interesting experiment in middle class land colonization has been inaugurated at Maddur Taluk, Mysore, on an area of red loamy soil under the Irwin Canal Scheme. 10 colonists (some of whom are graduates in agriculture) have been selected and each has been alloted 25 acres of land, 15 of which are irrigable. The land is ploughed by tractor and discharrowed before it is given over to the colonists. A deposit of Rs. 1,000 was paid by each colonist. The colonists are compelled to follow the advice and directions of the Agricultural Department officers in all matters connected with the scheme. In the first year cigarette tobacco was cultivated, and yielded, with manuring, 5,000–6,000 lb. of green leaf per acre ; 5–6 acres were cultivated by each colonist. The dry crops included in the cultivation programme are : kurakkan, sorghum, gingelly, castor, cowpeas, groundnut, *Dolichos lab-lab* and pasture or fodder grass. On the irrigable land, the crops proposed to be cultivated are tobacco, cotton, paddy, sugar cane, kurakkan and groundnut. Money is to be lent to the colonists at the rate of Rs. 1,000 per annum for the first two years and at Rs. 500 per annum for the next three or four years, and is to be recovered from the crop returns.

(5) *The Utilization of Nelli (S) (Phyllanthus emblica) as a Source of Vitamin C.*—At the Coonoor Nutrition Research Laboratories *nelli* (S) fruit which is a very rich source of vitamin C, is dried in the sun, ground finely, mixed with talc in the proportion of 10 of the *nelli* flour to one of the latter, and made into tablets for supplying troops. Each tablet contains 5–8 mgm. of ascorbic acid. Work carried out by us at Peradeniya on local *nelli* showed that while the fresh fruit was a rich source of vitamin C, though not as rich as the Indian product, a very high proportion of the vitamin was lost during sun-drying. Further work is being undertaken on this subject.

(6) *Insects as Test Animals for Nutritional and Vitaminic Studies.*—At the Indian Institute of Science, Bangalore, interesting experiments have been conducted with the rice moth as a test animal for studies on the vitamin B contents of foods. Fed *en masse* on a diet devoid of vitamin B1, the moths showed poor growth, while those treated with a full diet followed the normal course of development. The experiments indicated that sorghum constitutes a complete and adequate diet and hence a good source of vitamin B1, to these insects. In view of these findings, the rapid development of the rice moth in unpolished rice, which is a good source of vitamin B1, can be well understood.

(7) *The Malting of Grains.*—Methods have been worked out by the Agricultural Chemist, Madras, and Dr. B. N. Sastri of the Indian Institute of Science for the preparation of malted grains and malt extracts. At Coimbatore, sorghum (*cholam*) is the chief grain to which attention has been directed. The process is described in leaflet No. 4 of the Madras Department of Agriculture, entitled "Malt from Cholam". Dr. Sastri has prepared a malt extract from kurakkan. This grain, he has found, is a complete food so far as proteins are concerned. Work on this subject has just been started in this laboratory.

(8) *The Ganeshkand Fruit and Cold Storage Experiment Station, Poona.*—This is the main horticultural station of the Bombay Presidency and is under the direction of Dr. G. Cheema, Horticulturist, who is also in charge of the cold storage research station. The fullest facilities are available at the station for the conduct of cold storage trials, while limited facilities also exist for work on the gas storage of fruit. A full-time chemist is attached to the station.

(9) *The Lyallpur Fruit Preservation Laboratory.*—At the Agricultural College, Lyallpur, Punjab, a fully-equipped laboratory exists for the investigation both on a laboratory and semi-commercial scale of problems relating to the canning and bottling of fruit, fruit juices, fruit preserves, &c., and the cold

storage of fruit. A whole-time reserach chemist is attached to the laboratory. The semi-commercial production of bottled citrus juices is undertaken in the institution.

(10) *The Crop Water Requirement Research Station, Lyallpur, Punjab.*—This station, situated a few miles from Lyallpur, is under the charge of the Professor of Agriculture, Lyallpur Agricultural College, who is assisted by a staff of five research officers. The station has a well laid out irrigation system permitting of the accurate measurement of the water supplied to a crop which is led into the fields through open concrete flumes. Trials are being carried out with the irrigation requirements, under varying cultural conditions, of sugar cane, wheat, cotton, and other crops.

(11) *Ranawara (S) (Cassia auriculata) Bark as a Source of Tannin.*—The bark of *Cassia auriculata* (*ranawara* S) finds wide application in producing a satisfactory half-tanned leather, owing to its high tannin content (about 13 per cent.). The material is obtained by coppicing the tree, drying the stems and removing the bark mechanically. It is reported that there is a good market for the bark in India. There would appear to be good scope for developing this industry in the dry sandy areas of Ceylon, *e.g.* Paranthan, and Puttalam districts, where the plant grows freely.

(12) *Useful Trees along Roadsides, &c.*—All over Mysore and Madras avenues of tamarind are common along the main roads. In certain parts of India avenues of mango trees have also been observed. Roads in our dry zones may advantageously be lined with such trees or others useful to man and beast. In Madras, *Sesbania grandiflora* (*Katuru murunga* S) is used as a hedge plant or as standards for betel vines. This is a practice worthy of emulation by local betel cultivators.

SELECTED ARTICLES

COCONUT OIL*

DEVELOPMENTS in the Pacific focus attention on coconut oil. Even though there is at present a marked scarcity of bottoms to carry coconut oil from Philippine ports to the United States, actual hostilities would make this situation more acute. In all likelihood, supplies of coconut oil would be shut off from the rank and file of the soap industry. Those soapers who have anticipated this situation to some extent, and who have large stocks of coconut oil on hand, would be able to carry on until the exhaustion of their stocks. After that, it would be a case of getting along as best they could with little or no coconut oil.

If there is one oil which has always been considered indispensable in soap manufacture, it is coconut. The great bulk of our toilet and laundry soaps would suffer without it, particularly when they are used in hard water districts. The liquid soap and shampoo manufacturers would be just about crippled, for to-day about ninety per cent. of all such products are made from coconut oil. Those who depend on the lauric acid esters of coconut oil for the manufacture of lauryl alcohol detergent derivatives would be in the same boat. All told, a shortage of coconut oil is probably the most serious of all fat or oil shortages for the soap industry.

The prospects of substitutes for coconut oil are not bright. Babassu oil, potentially a large tonnage item with characteristics similar to coconut is in no position to-day to replace any material part of coconut tonnage. The same is true of palm kernel oil. Synthetic lauric acid is still of insufficient production to be a factor. Beyond these, there are no suitable substitutes.

With an American public which has been educated to the free-lathering properties of soaps and shampoos containing coconut oil in good proportion, the effects of coconut oil conspicuous by its absence can well be imagined. In Brazil, there should lie the opportunity in a coconut scarcity to exploit babassu oil in a manner which has never existed before. But are they smart enough to do it,—or will they immediatey go to work to kill the goose that lays the golden eggs, as they are doing in the case of carnauba wax ?

Let us all sincerely hope that the supply of coconut oil will not be shut off for the seriousness of any such situation would not be fully realized until it were actually upon us. A little is better than no coconut oil at all !

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* Editorial from *Soap*, 1941, Vol. XVII., No. 8, August, 1941. (New York, U. S. A.)

MANURING OF MANGO TREES: THE PRESENT POSITION*

MANURING in the case of mangoes is best divided into two parts: (1) manuring desirable in the preparation of an orchard; and (2) the manurial requirements of the mango plants in a growing orchard.

With regard to (1), R. G. Allan in Modern Mango Cultivation (Bulletin No. 13, Department of Agriculture, United Provinces) gives the following information:—

"The general tendency of most growers is not to provide enough manure. Manuring should be done by using leaf manure, well rotted farmyard dung or well decomposed compost or a mixture of these. Forty pounds of this per tree is not by any means excessive. Commercial orchard practices elsewhere advise as much as a maund to a maund and a half per tree, although in the last case the soils in which the trees were being planted were of lower fertility than those of the United Provinces. Another important addition to the pit contents is bone. This should take the form of bonemeal, not broken bone pieces, in quantities of between 5 to 10 lb. per pit. Again, if wood ash is available, the manure given to the tree will be improved by like amounts of this or in its absence, commercial sulphate of potash at about half the rate for wood ash.

Warding off white ants.

As recorded above, the major part of this mixture should be worked into the soil used in the lower part and rather less should be included in the soil of the top foot. To the latter, however, it is useful to mix in addition 2 lb. of neem cake or 4 lb. of mohwa cake, as these, in addition to supplying food, tend to keep away white ants, one of the chief enemies of the young orchard. It is suggested that with the soil and silt used to fill the lower 2 ft., 30 to 40 lb. coarse manure, 6 lb. bonemeal, and 6 lb. wood ash should be used while to the soil for the top foot should be added to 10 lb. old manure, 2 to 3 lb. bonemeal and 2 lb. neem cake. The soils so treated should be returned to the pit in layers, firming each layer as it is put in. This should be completed before the rains and left to settle down under the influence of the early showers before planting is done. The sub-soil from the pit, if not used in filling because of its poor quality or the easy presence of silt, can be utilized either to level up local depressions or in constructing thallas.

(2) The manuring of the growing orchard is a subject which has not received close experimental attention and it is, therefore, less easy to be definite about this. Allan, in his book quoted above, says: "Successful manuring must ensure a good tree growth without detriment to yield and good yield without

* By S. C. Roy, M.Sc. B.Sc. (Lond.) Assistant Agricultural Commissioner with the Government of India in *Indian Farming* Vol. II., No. 11, Nov., 1941.

detriment to quality. The common dressing given by many growers is only 10 lb. of farm-yard or leaf manure per annum per tree. This is definitely, even allowing for the fertility of the United Provinces soils, on the low side and could be profitably increased.'

Bombay practice.

The Department of Agriculture, Bombay, advises 20 lb. farmyard manure, 5 lb. bonemeal and 10 lb. wood ash at the close of the first year, with additions each year of 10 lb. farm-yard manure, 1 lb. bonemeal, and 2 lb. wood ash till the total per tree is 100 lb. farmyard manure, 15 lb. bonemeal, and 30 lb. wood ash. If green manuring with sanai is done in the rains the farmyard manure can be considerably reduced, in fact almost discarded, but the minerals should continue.

Research workers in other parts of the world vary in their opinion as to the desirability of heavy or nitrogenous manures once the tree is in bearing, but all formulae for the manuring of mango emphasize the need of phosphoric acid as supplied by bonemeal or superphosphate and potash as supplied by wood ash or sulphate of potash. The presence of ample supplies of these influence fruit yield, fruiting regularity and the quality of the fruit. They indicate that farmyard manure can be given in increasing amounts up to the fifth or sixth year but that after that it is inadvisable to give this except on poor soils but that the minerals are essentials. Trees should receive, when the diameter of the crown is approximately 15 ft., 9 lb., per annum of a mixture made up in the proportion of 100 lb. superphosphate (17 per cent.) and 15 lb. sulphate of potash or 8 lb. of a mixture made up at 90 lb. bonemeal and 15 lb. sulphate of potash given in two dressings in the year, once with the opening of the rains and again at the ploughing after the rains close. This quantity is reduced in amount or increased in proportion when the diameter of the crown is less or more than 15 ft.

In regard to the United Provinces, the heavy manurial dressings advocated in Bombay seem too large."

U. P. recommendations.

Mr. Allan suggests the following :—

" (1) 10 lb. farmyard manure, good leaf mould or compost increasing in 10 years by 3 lb. to 5 lb. per annum to 40 lb. or 55 lb.

(ii.) 3 lb. neem cake increasing in 6 years by $\frac{1}{2}$ lb. per annum to a maximum of 6 lb.

(iii.) 3 lb. superphosphate or bonemeal and 1 lb. of sulphate of potash increasing in 10 years by $\frac{3}{4}$ lb. up to a combined maximum of 12 lb.

If the general growth of the trees is too vigourous after definite fruiting has been established (ii.) of the above can be cut down or withdrawn. All manuring of a mango tree should be done in a ring or if intercropping is done, a square round the tree, starting the ring or the square with its inner edge 1 ft. from the tree and increasing this from the tree by 6 to 9 in. in accordance with tree vigour further from the tree each year or so as to lie 1 ft. or 1 ft. 6 in. inside the crown of the tree. The manure should be applied in a trench 6 in. deep,

2 ft. wide to begin with, increasing gradually in cross section to 4 ft. or 4½ ft. in width as the tree grows. It is useless applying manure near the stem of the tree and it becomes more useless every year the tree grows.

Manuring is probably best done in October and early November after the roots have been opened out and aerated. As an alternative practice some growers advice the application of (i.) at the beginning of the rains when the land is first ploughed, and (ii.) and (iii.) in October when the second general clearing of the garden takes place."

In the Philippines.

P. J. Wester in his book, The Mango (Bulletin No. 18 of the Philippines Bureau of Agriculture) writes :—

" The soil in the Philippines is in general sufficiently rich in all elements for the development of the trees. In fact, it seems to be well supplied in nitrogen and in consequence the trees develop top at the expense of fruit production. During the early development of the trees, artificial fertilizer is ordinarily an unnecesary expenditure in the Philippines but later when the trees come to bearing to counteract the influence of a superabundance of nitrogen in the soil, it would seem reasonable that the judicious applications of a fertilizer containing potash and phosphoric acid would increase fruit production. These applications should be made from September 1 to about January 1 and not during the spring or summer months. The application of well decomposed stable manure to the young trees will hasten their development but when they become of fruiting age it is best to use it only on very poor soils."

Wilson Popenoe in Tropical and Sub-tropical Fruits says : " Recent experiments indicate that a liberal application of potash is extremely beneficial. A standard commercial fertilizer specially prepared in Florida for use of mango trees contains amonia 5 to 6 per cent., phospheric acid 7 to 9 per cent. and potash 9 to 11 per cent. These elements are derived from ground bone, nitrate of soda, dried blood, dissolved bone black, and high grade potash soils."

Woodrow recommends for India that young trees be fertilized liberally with barnyard manure : but he adds that as soon as they come into bearing, the application of manure must be stopped and leguminous crops planted between the rows.

P. J. Wester in the book already quoted says : " Judging from the experience in Florida, a formula calling for 8 per cent. phosphoric acid and from 3 to 4 per cent. potash is likely to answer. Such a fertilizer can, to the best advantage be made from 450 kilos super phosphate (17 per cent.) and from 60 to 80 kilos high-grade sulphate of potash (50 per cent.). About 2 kilos of this mixture should be applied twice a year and coincident with the ploughings at the beginning and close of the rainy season to a tree with a crown diameter of 5 metres, larger trees receiving proportionately larger amounts. Or 400 kilos bonemeal (20 per cent. phosphoric acid, 5 per cent. nitrogen) might be substituted for the superphosphate which would also give the mixture 2 per cent. nitrogen. The fertilizer should be broadcast on the ground away from the trunk in a circle under slightly outside the crown."

Organic manure.

P. H. Rolfs in Bulletin No. 127 of the University of Florida writes : " The mango tree is as sensitive to the kind of fertilizer as is the citrus tree. During the early growth of the tree, and before it begins to produce a crop, organic ammonia such as dried blood or cotton-seed meal may be used at times to advantage ; but this is easily overdone, and then frenching of the tree will occur, even in the nursery rows. A good and fairly safe fertilizer for nursery trees and newly set groves may be made of the following ingredients ; sulphate of ammonia 125 lb., dried blood 200 lb., high-grade sulphate of potash 200 lb. and acid phosphate (14 per cent.) 800 lb.

The amount of this fertilizer to be used will have to be determined by the conditions : but from 1 to 3 lb. per tree for the first year, with probably double the amount for the second year, would seem to be sufficient under ordinary conditions. The fertilizer should be scattered in a circle not less than 4 ft. in diameter and well worked into the soil. For bearing mango trees a good fertilizer may be made up from 250 lb. sulphate of ammonia, 300 lb. high-grade sulphate of potash, and 850 lb. (14 per cent.) acid phosphate. Large bearing trees may be given from 10 to 40 lb. per year. One-fourth may be applied about the first of October, one-half about the middle of January, and the remainder about the first of March. The amounts should be varied according to the needs of the tree. A tree exhausted by a heavy crop should have an application of 1 to 5 lb. of sulphate of ammonia or nitrate of soda immediately after the crop has been taken off.

Remedy for dry periods.

During excessive dry periods, the ammonia of the soil available to the tree becomes too low for the health of the tree as shown by a loss of green colour. This may be partially remedied by an application of nitrate of soda or nitrate of potash at the rate of one to several pounds per tree according to the individual need. During some years a period of heavy rains occurs and the available ammonia is leached out of the soil. After such periods the trees take on a yellowish and sickly look. This can be quickly remedied by an application of nitrate of soda.

It frequently happens that mango trees, even with the best care and attention and with a reasonable amount of fertilizer, fail to respond and grow. Such trees are frequently helped materially by being given an application of stable manure. Stable manure used as a constant fertilizer will be found as unsatisfactory in the mango grove as in the citrus grove. It is not advisable to use any stable manure in grooves that are making a reasonably good growth."

W. T. Pope in Bulletin No. 58 of the Hawaii Experiment Station states : " No systematic and careful experimenting with fertilizer for mangoes has been done in Hawaii. The station has from time to time fertilized the old mango orchard with well-rotted barnyard manure at the rate of about 10 tons per acre ".

J. E. Higgins in Bulletin No. 12 of the Hawaii Experiment Station states : " No systematic and careful experimenting with fertilizers for mangoes has

been done in Hawaii. Experience in India has led to the use of bones in the holes where mango trees are to be planted, and this has produced good results, the bone furnishing both phosphoric acid and nitrogen."

Use of Salt.

Woodrow, in Gardening in India, states that in some of the very rainy districts it is customary to apply salt at the rate of about 10 lb. per tree several months before flowering should take place. The object of this seems to be to arrest the growth in order that the tree may mature fruit buds. In the German journal Der Tropenpflanzer, 1938, there is an article " Die Dungung im Obstbau Der Tropen Und Suptropen" (Manuring in tropical and subtropical fruit culture). The following very short reference is included in it : " Mango, etc., etc. For these sound experimental results are not forthcoming. There are, however, various findings among which are those of Jacob and Coyle who recommend the following for established plantations as annual dressings : 40 to 50 kg. nitrogen, 60 to 80 kg. phosphate and 100 to 150 kg. potash per hectare."

In pounds per acre these figures mean 45 to 56 lb. of nitrogen per acre ; 67 to 112 lb. of phosphate per acre ; and 112 to 168 lb. of potash per acre.

MEETINGS, CONFERENCES, &c.

REPORT OF THE PROCEEDINGS OF THE FOURTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD AT PERADENIYA IN THE BOARD ROOM OF THE DEPARTMENT OF AGRICULTURE AT 2-30 p.m. ON MONDAY, NOVEMBER 3, 1941.

Mr. E. Rodrigo, Director of Agriculture, presided and the following members were present :—Sir Wilfred de Soysa, Sir J. P. Obeyesekera, Dr. S. C. Paul, Mudaliyar S. Muttutamby, Messrs. Wace de Niese, A. A. Wickramasinghe, J. J. Heider, R. H. de Mel, L. L. Hunter, S. Sivapalan, M. M. Ebrahim, T. M. Saba-Rutnam, K. Kanakasabai, A. E. Madawala, T. B. Panabokke (Adigar), L. B. de Mel, T. B. Ellepola, Colonel T. Y. Wright, Dr. A. W. R. Joachim (Chemist), Dr. Reginald Child (Director, Coconut Research Scheme of Ceylon), Mr. T. E. H. O'Brien (Director, Rubber Research Scheme of Ceylon), Dr. R. V. Norris (Director, Tea Research Institute of Ceylon), Messrs. M. Crawford (Deputy Director, Animal Husbandry and Government Veterinary Surgeon), Malcolm Park (Acting Deputy Director of Agriculture), A. M. Clement Dias, Marcus S. Rockwood, Bruce S. Gibbon, C. Arulambalam, Wilmot A. Perera, Dr. J. C. Haigh (Botanist), Messrs. G. de Soyza (Registrar, Co-operative Societies), C. E. Hamilton, H. W. Amarasuriya, M.S.C., R. H. Basset (Commissioner for Development of Agricultural Marketing), A. P. Weir (Acting Director of Irrigation), Dr. W. R. C. Paul, Mr. R. C. Kannangara, M.S.C., Mr. C. N. E. J. de Mel (Principal, School of Agriculture, Peradeniya), Mudaliyar N. Wickramaratne, Mr. U. B. Unamboowe, Mudaliyar H. E. S. -Wickramaratne, Mr. C. L. Wickremesinghe (Commissioner of Lands), Mr. E. R. Tambimuttu, M.S.C., Mr. N. H. W. Dulling (Vice-Chairman, Planters' Association of Ceylon), and Mr. S. C. Fernando, Secretary.

The following members had expressed their inability to be present :—Rev. Father L. W. Wickramasinghe, Messrs. W. H. Attfield, R. H. Spencer-Schrader, Geo. E. de Silva, M.S.C., F. A. E. Price, W. C. Lester-Smith, Bertram de Zylva, and the Conservator of Forests.

The following visitors were present :—Dr. A. Nell, J. P. Blackmore, W. M. Rogers, G. V. Wickramasekara, J. G. Jeffrey, and C. Charavanapavam.

The minutes of the previous meeting were confirmed.

The following change in personnel was announced :—Mr. A. P. Weir, Acting Director of Irrigation, in place of Mr. S. G. Taylor, Director of Irrigation, on leave.

ACTION TAKEN ON PREVIOUS RESOLUTIONS

The following statement was tabled :—

Planting Waste Land in the Dry Zone with Palmyrah

This was referred to the Forest Department through the Hon. the Minister for Agriculture and Lands. Action on a large scale was not favoured as

its economic forestry value was reported to be small. However, the Department of Agriculture has decided to encourage the planting of palmyrah in open spaces near village settlements in the dry zones, to be extended further in due course to more remote areas as the population becomes aware of the usefulness of this tree, and the Director has already given instructions to local staff for this purpose.

Cattle Centres for Selective Breeding to Serve as Models

Mr. R. H. Spencer-Schrader's resolution and memorandum were considered by the Executive Committee. As a result of the decision the Executive Committee was of the opinion that two centres on the lines envisaged by Mr. Schrader might be tried one in the Welimada District and one in the Hambantota District. A scheme for starting two such centres was drafted and forwarded to the Hon. the Minister for his approval and for instructions as to the manner in which the necessary financial provision should be made.

A vital point in Mr. Schrader's scheme was that the cattle concerned should be of the local village type.

The Hon. the Minister is of the opinion that since improvement of the local cattle by selective breeding must necessarily be a long term project such work should be done by Government itself. He does not consider such long term improvement work is suitable for villages. He has no objection to such work being done by the Department of Agriculture on its own farms.

SPECIAL COMMITTEE TO REPORT ON THE ORGANIZATION OF CATTLE BREEDERS' ASSOCIATIONS IN THE VILLAGES FOR THE IMPROVEMENT OF INDIGENOUS STOCK

This committee decided to advise the Director of Agriculture, Mudaliyar N. Wickremaratna dissenting, that 2 or 3 villages near Nikaweratiya should be selected as an experiment for the promotion of associations under the guidance of the Department, details to be worked in an experimental way to ascertain the feasibility of controlled registration, castration, feeding and breeding up in the selected areas. The Director of Agriculture will proceed on the basis of this advice.

CLASSIFICATION OF PADDY LANDS

The Executive Committee met twice to decide on a suitable report to the Hon. the Minister for Agriculture and Lands but deferred further consideration till more information was called for and received from the Director of Irrigation and the Revenue Officers.

REPORT TO THE BOARD ON A PALMYRAH RESEARCH SCHEME

The following report by the Executive Committee was considered and accepted by the Board subject to the following amendment moved by Dr. R. Child, Director, Coconut Research Scheme. In place of the words *the Coconut Research Scheme* the words " the existing Government Departments and the Research Institution " be substituted.

REPORT ON A PALMYRAH RESEARCH SCHEME

The objects of the mover were carefully considered. It was felt that existing schemes in Ceylon dealt with commodities consumed largely on a commercial scale abroad and their work was mainly agricultural research.

The export trade in palmyrah products was negligible and it was very unlikely that potential markets of the world would turn even to improved products as substitutes. Local uses were already well known and if research was called for in any particular line the existing Government Departments and the Research Institutions with their present staff could undertake it.

It was unanimously agreed that expenditure on a special scheme was therefore not warranted at present.

TOBACCO GROWING IN CEYLON

Mr. C. L. Drake, Director, Ceylon Tobacco Company, Limited, who was present by invitation, then gave an address on Tobacco Growing in Ceylon.

This address aroused considerable interest, and information was sought by members on the policy of the Company and the attitude of the Department and Minister. To an inquiry whether the grower was paid an adequate price the Honourable the Minister replied that the policy had been decided at a Conference with the Company's representatives and he could assure the Board from his experience that the Company was not making large profits as was generally believed ; on the contrary as it paid for the experts, erected curing barns and bought all the crop grown at a fixed price without undue strictness over quality, it often had to face a loss. If the Department undertook what the Company was doing he would have had to go to the State Council for funds to meet the losses.

The present aim was to teach the cultivators to grow tobacco and grow it well under supervision. The Company bought all the leaf now, even what was unsuitable for cigarettes.

Mr. Arulambalam inquired what success there was with new types of tobacco. The Minister replied that the Department was still experimenting. White Burely had been recommended but there was no demand from London.

Mr. E. R. Tambimuttu suggested more drastic steps to prevent the smuggling of beedi.

RESOLUTIONS

The following resolutions by Mr. A. A. Wickramasingha were then considered :—

(*a*) This Board is of opinion that adequate provision should be made to provide both advanced courses of study as well as practical training in estate management as a post graduate course to qualified students.

(*b*) This Board is further of opinion that provision should be made for such students to reside at the various Research Centres, to wit :— Tea, Rubber and Coconut Research Schemes.

The mover said that Ceylonese were not successful planters, as a rule, because the facilities to train them were inadequate. Besides, the least intelligent members of a family were usually sent out to be planters.

He suggested that students after their course at the School of Agriculture, Peradeniya, should be sent to the Research Institutes to complete their training. Without some such training employment would not be available to them on large estates.

Sir Wilfred de Soysa, seconding, said the practice in other countries was to give such intensive training. As one of the earliest to go from Ceylon in 1903 for a training at the Royal Agricultural College, Cirencester, he could recall the grounding the students received in practical agriculture by visiting various farms and stations.

Dr. Norris, Director, Tea Research Institute, discussed the question under three heads :—

(*a*) Post Graduate Science Training.

(*b*) Estate Management.

(*c*) Accommodation.

In Java he found the standard of agricultural training among assistants on estates relatively high. Many were degreed men. For some years, he had urged that men engaged for estates in Ceylon should receive some preliminary agricultural training prior to recruitment, but little had been done in the matter.

In June, 1938, his Institute had considered the facilities available there to give such a training, but the laboratory equipment could not provide for more than one graduate in each section, *i.e.*, 5 in all. Even then there were practical difficulties. There was the question of accommodation and funds.

Estate Management was really a separate question. He did not think the Companies had thought so much of scientific knowledge in admitting recruits. Research training alone might not qualify a man to work on a Company estate in the absence of practical experience in the business side of an estate. He felt that the Research Institutes were not suitable places for training young men in commercial estate management.

Mr. Heider thought the problem could be solved by making the graduate apply for employment on a European estate. He would be prepared to admit a man to his own, at Palugaswewa, and pay a suitable salary.

Col. Wright said he had had great experience regarding Ceylonese planters and the great majority of them were excellent planters. He could not understand the urge for so much scientific knowledge except possibly in tea manufacture, the great thing was to have practical knowledge in estate working and the management of labour.

Mr. O'Brien, Director, Rubber Research Scheme, said his Board had already considered the question of training students on several occasions. The principle was adopted that training should only be given if it could not be obtained elsewhere. One student had been given a course of training in rubber technology, and courses in budgrafting had been conducted for some years. It was considered that training in practical estate management could be given more effectively on commercial estates. The Board would be prepared to accept 3 science graduates for training in research methods, one in each department, provided that suitable arrangements could be made by Government for accommodating the students and payment of subsistence allowances. The proposal could not, however, be put into effect at present owing to the periodical absences of technical officers on military service.

Mr. H. W. Amarasuriya thought there should be change of heart in Estate Agents. He commended Mr. Heider on his offer.

Mr. Wilmot A. Perera said he believed there was compulsory legislation in the Dutch East Indies to take in a certain number of local men.

Dr. Child, Director, Coconut Research Scheme, said his Scheme had already taken what action they could and there was already a Research Probationer on Rs. 100 a month.

Mr. C. N. E. J. de Mel, Principal, School of Agriculture, remarked that the future of Agricultural Training in Ceylon was already being canvassed with the Principal of the University College. The English practice referred to by Sir Wilfred de Soysa was being followed already in his School.

The mover, replying, said he thought training should come first and employment would follow.

The Chairman, winding up, said he thought that the reference to " advanced training as post graduate courses " on the resolution had perhaps misled some speakers. The mover was probably not thinking of post graduate work in research ; but the training of graduates in practical estate management.

An agricultural faculty was likely to find a place in the New University. In the meantime he thought Mr. Heider's suggestion the best to meet the situation.

The resolutions (*a*) and (*b*) were put to the house separately. The first was carried by 3 to 1 but the second was lost by 8 to 2.

After resolution (*b*) was rejected Dr. Norris explained that he voted against it because he could not support a proposal to give training in estate management at the Research Centres. He thought that facilities could be provided for post graduate training in research, but even such provision should be deferred for the duration of the war owing to depleted staff. Therefore he thought that the Tea Research Institute could not expect to undertake wider responsibilities in providing those facilities at the present time.

AGRICULTURAL SCHOOLS

The following resolution was then considered:—

" This Board recommends to the Honourable the Minister for Agriculture and Lands to investigate and consider the urgent need for the establishment of Agricultural Schools under the management of the Department of Agriculture, in Provincial or District centres for the training of the village youth from their 14th year and up to the 19th in agriculture and animal husbandry ".

In moving it Mudaliyar H. E. S. Wickramaratne requested and obtained the permission of the Board to make a slight amendment by adding " practical " before " agriculture " in the last line.

He agreed that existing schools and stations could be used for the purpose but his intention was that the course should last at least five years. In Matara District there was good scope for such employment after a training like this.

Mudaliyar N. Wickramaratne seconded and Mr. Arulambalam spoke in support.

The Chairman, intervening, explained the scope of the existing schools, and pointed out that the present accommodation would limit the number of students in training severely if the course had to last 5 years instead of 2 as now. Even now there were no more than 20 annually.

The mover replying said he contemplated a scheme for " external " students as well.

The resolution was lost.

FOOD PRODUCTION

Mudaliyar N. Wickramaratne having agreed to waive a resolution by him on the same subject the following was moved by Col. T. Y. Wright on behalf of the Planters' Association of Ceylon.

> "That as rice is the staple food of the peoples of this Island it is of the utmost importance that all available uncultivated land which is at present irrigable should be brought under immediate cultivation. While appreciating the enormous efforts of the Minister of Agriculture in increasing the supply of rice at Minneriya and Minipe, &c., it is considered that quicker results will be obtained by making available to villagers all uncultivated lands suitable for paddy cultivation in the vicinity of their villages where the labour for such cultivation is already permanently resident ".

Col. Wright said that he had been requested by the Planters' Association to move this resolution as Mr. Dulling was a deputy for another member of the Board and he could neither move a resolution or speak to it without the permission of the Chairman and he asked the Chairman to allow Mr. Dulling to speak to the resolution later.

At the same time he urged the importance of producing rice to the utmost capacity to-day and he wished to make it clear that this resolution was in no way whatever a reflection on the efforts made by the Minister of Agriculture in such rice producing schemes such as Minneriya and other schemes which had always had his full support, if it was otherwise he would not be proposing this resolution to-day.

He was informed at a recent meeting of the Board of Agriculture that there were 92,000 acres of paddy land uncultivated.

Mr. C. E. Hamilton seconded.

Mr. N. H. Dulling, Chairman, Matale Planters' Association, speaking in support said he had reason to believe that there was a shortage of buffaloes for cultivation. If according to figures given 11,000 neat cattle and 600 buffaloes were slaughtered last year for consumption then some restriction should be imposed, or vigorous breeding carried out on State farms.

Mr. E. R. Tambimuttu thought there was some misconception about irrigable land which probably arose from certain remarks of the Director of Irrigation in his Administration Report. What the Director had urged was the necessity to make more use of the rains by advancing the cultivation season.

Mr. R. C. Kannangara said he thought the Government Agents were not enthusiastic enough.

Mr. R. H. Bassett contributing to the discussion said he was buying at a fixed price all the paddy that his mills could cope with, and under a quota the produce of the mills was sold at a fixed price to the importer.

Replying to a complaint from Mr. Bruce Gibbon about weevils found in bags sent from the Marketing Department he disowned responsibility as the importer himself appeared to be the person to blame. His own bags were free of infection when packed at the mills with locally milled rice.

The Honourable the Minister intervening at this stage said he thought Col. Wright's figure, 92,000 was exaggerated. Actually all the irrigable land was being cultivated to-day, especially when prices were so good. The trouble was the tremendous waste of water referred to by the Director of Irrigation.

He then outlined the quicker methods he had in view, with tractor machinery to open up new land, likely to be available soon under Lease and Lend arrangement with the United States of America. There was also the possibility, he added, of requisitioning the services of Italian Prisoners of War with experience of rice cultivation, to help in the Food Drive. The Director of Irrigation had already interviewed some of them.

Mr. C. L. Wickremasinghe proposed that the resolution should be amended by the insertion of the words " and that the Executive Committee of the Central Board of Agriculture should submit to Government concrete proposals for obtaining these results ". The amendment was seconded by Mr. T. B. Panabokke, Adigar, and accepted by the mover and seconder of the original resolution. The resolution as thus amended was passed.

It being past 6.10 P.M. the meeting closed.

S. C. FERNANDO,
Secretary, Central Board of Agriculture.

Peradeniya, November 28, 1941.

COCONUT RESEARCH SCHEME

BOARD OF MANAGEMENT.

DRAFT MINUTES OF THE FIFTY-SEVENTH MEETING OF THE BOARD OF MANAGEMENT, COCONUT RESEARCH SCHEME, HELD AT BANDIRIPPUWA ESTATE, LUNUWILA, ON FRIDAY, DECEMBER 19, 1941, AT 10 A.M.

PRESENT.

Mr. E. Rodrigo, C.C.S., Acting Director of Agriculture, Chairman ; Mr. O. B. M. Cheyne ; Mr. D. D. Karunaratne, J.P. ; Mr. G. Panditesekera, J.P., U.M. ; Mr. C. A. M. de Silva ; Mr. E. R. Tambimuttu, M.S.C.

Dr. R. Child, Director of Research, acted as Secretary. Apologies for absence were received from Mr. C. E. Jones, C.C.S. (Deputy Financial Secretary), Mr. A. F. R. Goonewardene and Dr. S. C. Paul.

MINUTES.

The minutes of the previous meeting held on Friday, September 26, 1941, which had been circulated to members were confirmed.

BOARD OF MANAGEMENT.

The Chairman reported that the Low-country Products Association had nominated Mr. Chas. A. M. de Silva to serve on the Board in place of Mr. H. W. Peiris, whose three-year term of service expired on October 31, 1941. The Chairman welcomed Mr. de Silva to the present meeting. The Board placed on record its appreciation of the services of Mr. H. W. Peiris.

STAFF.

Research Student.—The Chairman reported that, in accordance with the Board's instructions at the previous meeting, the Director of Research had appointed Mr. V. Perampalam as Research Student from October 16, 1941. The Board approved.

BUILDINGS SUB-COMMITTEE.

The minutes of the 21st and 22nd meetings of the Buildings Sub-Committee had been circulated. The Chairman reported that the Ceylon kiln at Ratmalagara Estate had been satisfactorily completed at a cost considerably below the original estimate.

Mr. Cheyne drew particular attention to the question of rebuilding the copra store on Bandirippuwa Estate. The Board desired that the Director of Research should, in consultation with the Buildings Sub-Committee, prepare a plan and estimate for the next meeting.

The Board approved of other recommendations of the Sub-Committee.

ESTATES.

The Visiting Agent's Reports were tabled. The Chairman mentioned that since the V.A's report, the sixth and last pick had been collected at Ratmalagara Estate and the total crop for the year came to 252,297 nuts against 150,430 in 1940 and an estimate of 185,000. Mr. C. A. M. de Silva inquired the number of nuts per bearing palm, and whether the increased crop was largely due to young palms coming into bearing. The Director of Research said that full details would appear in the Annual Report, but he could say that the increase in the number of bearing palms was only about 7 per cent.

MISCELLANEOUS.

Mr. Menon's Work.—The Chairman reported that the Ceylon Coconut Board expected that a Pilot Plant for the preparation of press-boards from immature coconuts would be ready to commence operation in Colombo in January. It was decided to allow equipment purchased by the Coconut Board to be removed from the C. R. S. Laboratory for use by Mr. Menon in the new pilot factory, and offer to sell to the Coconut Board at cost price the laboratory equipment bought by the Coconut Research Scheme in connexion with Mr. Menon's research work at Bandirippuwa.

LOAN OF PHOTOGRAPHS.

The Chairman said that the Ceylon Coconut Board had in September, 1941, asked for the use of some of the photographs which appeared in Mr. Pieris' "Illustrated Guide to Coconuts" (1936) for propaganda purposes. The Director of Research had agreed to this, provided that due acknowledgement was made to Mr. Pieris and to the Scheme. The Board approved of this action.

LETTER FROM THE NORTHERN DIVISION CO-OPERATIVE FEDERATION, LTD.

A letter from the Hon. Secretary, Northern Division Co-operative Federation, Ltd., Jaffna, dated September 13, 1941, forwarding a copy of a resolution relating to improvement of the Coconut Industry, was tabled for information.

PATENT FOR POTASH RECOVERY.

The Board confirmed the Chairman's action in approving of a patent being taken out by Dr. M. L. M. Salgado, Soil Chemist, for a process of recovering potash in commercial form from coconut husk ash.

The Chairman said that he would report to the Board at an early date on the progress of the work, and the Board could then discuss the means whereby the process should be commercially developed.

CO-OPERATIVE EXPERIMENTAL WORK AT MATARA.

In reply to a question by Mr. C. A. M. de Silva, the Director of Research said that it was intended to start an experiment on an estate at Matara, provided that this could be supervised, without much extra staff travelling, by an officer at present visiting the experimental area at Ahangama. It was intended that the Soil Chemist or his Senior Field Assistant, on their next visit to Ahangama, should go on to meet the proprietor of the land in question.

The meeting terminated at 11.35 A.M.

3——J. N. A 8794 (12/41)

MEETINGS, CONFERENCES, &c.

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES OF THE FIFTY-NINTH MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE CHAMBER OF COMMERCE, COLOMBO, AT 2.30 P.M. ON MONDAY, DECEMBER 8, 1941.

PRESENT.

Mr. E. Rodrigo (in the Chair) ; Mr. C. E. Jones (Deputy Financial Secretary); Mr. W. P. H. Dias ; Mr. G. E. de Silva, M.S.C. ; Mr. T. C. A. de Soysa ; Mr. F. H. Griffith, M.S.C. ; Mr. R. J. Hartley ; Mr. R. C. Kannangara, M.S.C. ; Mr. F. A. Obeyesekera, and Mr. E. C. Villiers, M.S.C.

Mr. T. E. H. O'Brien, Director, was present by invitation.

Apologies for absence were received from Messrs. J. A. S. Agar, T. Amarasuriya, J. D. Farquharson, E. W. Whitelaw and L. M. M. Dias.

1. MINUTES.

Draft minutes of the meeting held on October 27, 1941, which had been circulated to members, were confirmed and signed by the Chairman.

2. BOARD.

The Chairman reported that :—

(*a*) Mr. E. W. Whitelaw had been renominated by the Rubber Growers' Association to serve on the Board for a further period of three years from December 14, 1941.

(*b*) Mr. J. A. S. Agar had been nominated by the Ceylon Estates Proprietary Association to serve on the Board for a period of three years from October 6, 1941, in place of Mr. J. C. Kelly, who had resigned.

3. SMALLHOLDINGS COMMITTEE.

Recommendations made at meetings of the Smallholdings Committee held on September 12 and November 5, 1941, were considered.

(*a*) *Joint work with Co-operative Department.*—Agreed that the necessary capital (about Rs. 2,000) should be advanced to enable a Rubber Producers' Co-operative Society to be formed, subject to payment of interest at 2½ per cent. per annum after the first year, and repayment of the capital in ten instalments after the first year.

(*b*) *Marketing of sheet.*—Agreed that the Research Scheme should establish and operate a buying agency for smallholders' rubber in a suitable centre for a trial period of one year, employing a manager on commission.

(*c*) *Coagulants.*—Noted that the Government Marketing Department had arranged to undertake the sale of acetic acid in sealed bottles, and that the statutory maximum prices had been adjusted to provide a reasonable margin of profit for the retail sale of acid in sealed bottles in outstations.

4. **STAFF.**

Decided that Mr. C. D. de Fonseka (Secretary to the Director) be promoted to the post of Secretary-Accountant on the salary scale previously approved for the Estate Superintendent.

5. **LONDON ADVISORY COMMITTEE.**

(*a*) Minutes of meetings of the London Advisory Committee for Rubber Research (Ceylon and Malaya) and the Technical Sub-Committee held on June 6, 1941, were tabled.

(*b*) The following changes in membership of the Committee were reported :—

(1) Mr. F. P. Jepson to represent the Government of Ceylon *vice* Dr. W. Youngman who had resigned.

(2) Mr. H. W. Horner to represent Ceylon Planting interests *vice* the late Sir Herbert Wright.

6. **PUBLICATIONS.**

The following publications were tabled :—

(1) Annual Report for 1940.

(2) 1st and 2nd Combined Quarterly Circular for 1941.

(3) Advisory Circular No. 2 (Revised October, 1941).

7. **DIRECTOR'S REPORT.**

The Director's report for the 3rd quarter, 1941, was considered and adopted.

8. **EXPERIMENTAL COMMITTEE.**

Recommendations made at a meeting of the Experimental Committee held on November 14, 1941, were considered.

(*a*) *Power requirements at Dartonfield.*—The Consulting Engineer's report on power requirements at Dartonfield was adopted, and it was decided to instal a 20–23 H.P. Gardner engine and electric generator. A sum of Rs. 9,000 was voted to cover the cost of purchase and installation, and extension of the engine room.

(*b*) *Labourers' quarters.*—The recommendation that all labourer's quarters be constructed of permanent materials was adopted. It was decided that a quadruple set of quarters be constructed in cement bricks with tiled roof at Dartonfield, and a similar set at Nivitigalakele. A vote of Rs. 6,000 was approved for the purpose.

(*c*) *Quarters for junior employees.*—Approval was given for the construction of one junior staff bungalow at Dartonfield in 1942. The Director was asked to submit plans of a cheaper type of bungalow than those previously erected.

It was also agreed that proposals be formulated for providing living accommodation for all minor employees at Dartonfield.

(*d*) *Test tapping at Wagolla.*—Decided that test-tapping of budded trees at Wagolla be discontinued after the next resting period, and that the lease of the land be relinquished.

(*e*) *Nederlands Indies Rubber Research Institute.*—Decided to offer the fullest co-operation to the newly formed Nederlands Indies Rubber Research Institute at Buitenzorg, Java.

9. **ACCOUNTS.**

(*a*) Statement of Receipts and Payments of the Board for the quarter ended September 30, 1941, was approved.

(*b*) Dartonfield and Nivitigalakele accounts for August, 1941, were tabled.

(*c*) Reported that Rs. 15,000 had been invested in Ceylon Government 3 per cent. War Loan 1956/60 on November 27, 1941.

(*d*) Reported that Rs. 20,000 had been placed on fixed deposit with the Imperial Bank of India for 12 months from November 28, 1941, at 1½ per cent. interest per annum.

The meeting terminated with a vote of thanks to the Chamber of Commerce for the use of the Committee room.

Research Laboratories,
Dartonfield,
Agalawatta.

December 23, 1941.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED NOVEMBER 30, 1941

Province, &c.	Disease	No. of Cases up to date since January 1, 1941	Fresh Cases	Deaths	Recoveries	Balance ill	No. shot
Western	Foot-and-mouth disease	104	4	1	91	13	..
	Rabies	27	5	10	..	..	17
	Piroplasmosis	1	..	..	1	..	..
Colombo Municipality	Foot-and-mouth disease	902	8	1	901	..	..
	Rabies	46	6	..	46	..	..
	Hæmorrhagic Septicæmia	1	..	..	1	..	..
Cattle Quarantine Station	Foot-and-mouth disease	5	..	..	5	..	..
	Anthrax	8	..	8	..	..	..
Central	Blackquarter	30	..	30	..	..	..
	Foot-and-mouth disease	5	..	..	5	..	..
	Piroplasmosis	6	2	1	5	..	..
	Rabies	55	4	9	..	..	46
	Bovine Tuberculosis	6	..	..	..	..	6
	Contagious Abortion	1	..	..	..	..	1
Southern	Foot-and-mouth disease	43	..	2	41	..	..
	Rabies	20	5	..	..	..	20
	Hæmorrhagic Septicæmia	53	..	53	..	..	..
Northern	Foot-and-mouth disease	248	..	..	248	..	..
Eastern	Foot-and-mouth disease	65	..	6	59	..	..
	Rabies	12	..	..	..	..	12
	Goat pox	4	..	2	2	..	..
North-Western	Mange	9	..	1	8	..	..
	Anthrax	24	..	24	..	..	..
	Rabies	11	1	..	..	..	11
	Piroplasmosis	3	..	2	1	..	..
North-Central	Foot-and-mouth disease	2	2	..	..	2	..
	Hæmorrhagic Septicæmia	43	..	43	..	..	..
Uva	Anthrax	87	2	87	..	..	..
	Blackquarter	13	..	13	..	..	..
Sabaragamuwa	Rabies	6	..	3	..	..	3
	Piroplasmosis	5	1	..	5	..	..

Department of Agriculture,
Peradeniya, December 29, 1941.

M. CRAWFORD,
Deputy Director (Animal Husbandry) and
Government Veterinary Surgeon.

METEOROLOGICAL REPORT, NOVEMBER, 1941

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta ..	84·8	—1·6	72·8	+1·0	84	93	7·1	26·58	25	—
Anuradhapura ..	84·5	—0·9	73·5	+1·7	84	98	8.0	10·65	25	— 0·89
Badulla ..	79·5	+0·3	67·5	+1·8	84	97	8·0	16·14	28	+ 6·12
Batticaloa ..	83·9	—0·2	75·4	+1·1	83	91	7·4	18·36	26	+ 2·48
Colombo ..	85·3	+0·4	74·2	+0·6	76	88	8·4	14·23	25	+ 1·89
Diyatalawa ..	73·7	—0·4	62·7	+2·5	85	97	8·6	8·82	27	— 1·37
Galle ..	83·5	+0·2	75·3	+1·1	82	91	7·6	11·09	21	— 0·05
Hakgala ..	69·4	+0·7	57·7	+3·2	93	97	9·0	12·80	28	+ 0·75
Hambantota ..	85·2	—0·1	75·7	+1·8	82	91	7·7	8·06	22	+ 0·28
Jaffna ..	83·4	—0·2	75·4	+0·7	86	93	8·0	26·30	27	+ 9·98
Kandy ..	83·9	+0·4	69·9	+1·7	81	95	9·0	14·15	27	+ 2·94
Kurunegala ..	86·2	—0·7	73·4	+1·4	80	95	9·0	18·73	27	+ 5·21
Lunuwila ..	85·9	+0·2	73·6	+1·0	84	98	7·8	20·35	28	—
Mannar ..	83·0	—1·6	76·6	+1·0	85	91	9·2	18·90	26	+ 9·05
Nuwara Eliya ..	67·4	0·5	55·7	+4·3	86	94	9·1	11·80	29	+ 2·29
Puttalam ..	85·6	+0·3	74·8	+1·6	84	95	8·1	24·01	27	+14·05
Ratnapura ..	86·0	—1·4	73·7	+1·3	87	98	9·0	17·45	24	+ 2·45
Talawakele ..	74·4	+1·1	60·8	+3·4	77	86	8·5	9·90	28	+ 1·32
Trincomalee ..	83·8	+0·5	75·5	+0·7	84	93	8·2	26·85	27	+12·59

The rainfall for November was above average over nearly the whole of the Island. The only appreciable area reporting deficits was the south-western quarter of the Uva Province. A few, more or less isolated, cases of deficits also occurred, chiefly in the hill-country and along the southern and south-western coasts.

The largest excesses were 20·80 inches at Pottuvil, 19·50 inches at Tabbowa, 19·19 inches at Eastern Saltern (Puttalam), 18·22 inches at Western Saltern (Puttalam), and 17·72 inches at Horawupotana. The only deficits over 5 inches were Kalutara 6·34 inches, Udahena 6·24 inches and Sudupanawela 5·09 inches.

The largest monthly totals were Dehiowita 41·16 inches, Bingiriya 35·76 inches, Mootootie 35·32 inches, while about a dozen other scattered stations also recorded totals of over 30 inches.

Altogether 42 daily falls of 5 inches and over were reported, of which 10 occurred on the 25th. The largest falls were 9·53 inches at Yataderia on the 27th, 8·50 inches at Battuluoya on the 18th and 8·40 inches at Kalmunai on the 25th.

The weather during the month was mainly governed by weak irregular pressure gradients, leading to general thunderstorm activity. Unsettled conditions prevailed from the 14th for a few days as a result of the formation to the north-east of the Island of a depression, which steadily developed into a cyclonic storm and moved away in a northerly direction.

Temperatures were mainly below average by day, and consistently above average by night. The highest shade temperature recorded was 92·8 at Puttalam on the 1st, while the lowest temperature was 50·6° at Nuwara Eliya on the 21st. Humidities were above average, and cloud amounts in excess. Surface winds were again consistently above average strength, the direction being variable.

D. T. E. DASSANAYAKE,
Superintendent Observatory.